PUBLIC WORKS

city county and state

march 1949

In this Issue:

Leaders in the Public Works Field

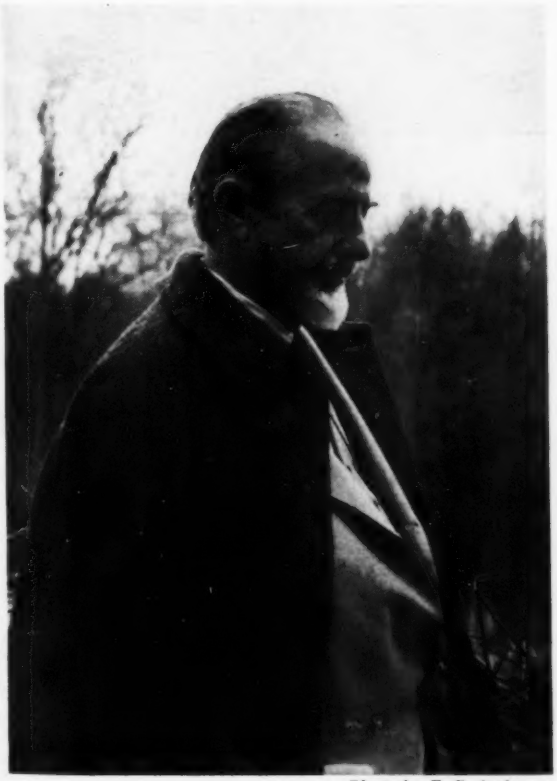

Photo by E. C. Anderson

J. V. N. Dorr

One of the real pioneers in the industry, and an engineer who contributed greatly to its progress, J. V. N. Dorr retired this winter from the presidency of the Dorr Company to become Chairman of the Board. He is known all over the world as an inventor, a scientist and, above all, as a leader of engineers.

THE COMPLETE HUBER TANDEM LINE

Gives You A ROLLER FOR ANY COMPACTION JOB

Make versatility the keynote in selecting your new road machinery. The ability of the Huber Tandem roller to do the work of a number of different size rollers with equal satisfaction is cutting investment and maintenance costs for many contractors.

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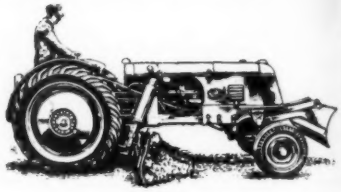
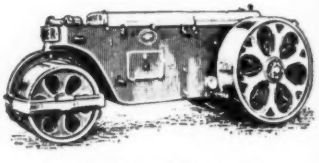


THE HUBER MAINTAINER
with bulldozer, patch roller, berm leveler, lift loader, mower, broom or snow plow attachments.



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Marion, Ohio, U.S.A.

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ROAD ROLLERS
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MAINTAINERS

VOL. 80 — PUBLIC WORKS — No. 3

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MARCH, 1949

"FORD F-8 Big Jobs outperform all other trucks in their class!"

Roadside Report

FORD TRUCKS

JAMES L. DIGGS
KINGMAN
ARIZONA

"MY BONUS BUILT Ford F-8 Big Jobs, averaging 46,000 lbs. gross, are outperforming all other trucks in their class," reports Mr. James L. Diggs. "Gas mileage is 6 miles per gallon. The engine on one F-8 has never felt a wrench, except for changing one set of points and two fan belts. My run takes us over a mountain range and through the intense heat of the Colorado River Valley."

Mr. Diggs is one of many big-time haulers who give the Ford Big Jobs a great big hand. Owners report the 145-horsepower engine outperforms anything in its class. They offer plenty of proof that it outsaves many engines much smaller in size. Drivers report that the new Ford Million Dollar Cab can't be beat for comfort. Ford Big Jobs for '49 are Bonus Built . . . like the other 139-plus models in the full line of Ford Trucks. Bonus Built is the superstrong construction that contributes to long truck life. Life insurance experts prove Ford Trucks last longer.

ONLY THE FORD BIG JOB HAS ALL THESE FEATURES!

- ★ New 145-h.p. Ford V-8 engine for top performance.
- ★ Ford exclusive concentric dual-throat carburetor for more power, more economy.
- ★ New heavy duty 5-speed transmissions for operating flexibility.
- ★ Big Ford power-operated brakes for sure-footed stopping; rear 16-inch by 5-inch on the F-8.
- ★ Ford Super Quadrax 2-speed axle with vacuum shift for performance flexibility in Model F-8 (single speed axle also available); single-speed Quadrax Hypoid Axle in Model F-7.
- ★ Large diameter (10-inch) wheel bolt circle with 8 studs to allow for extra-strong hub construction.
- ★ Million Dollar Cab with Ford Exclusive Level Action suspension for greater driving comfort.
- ★ Nationwide service from over 6,400 Ford Dealers.
- ★ Ford Bonus Built construction for long truck life.

Gross Vehicle Weight Ratings: F-8 up to 21,500 lbs., F-7 up to 19,000 lbs. Gross combination ratings: F-8 up to 39,000 lbs., F-7 up to 35,000 lbs.

FORD 1949 *Bonus Built* TRUCKS 1959

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USING LATEST REGISTRATION DATA ON 5,444,000 TRUCKS, LIFE INSURANCE EXPERTS PROVE FORD TRUCKS LAST LONGER!

When you need special information—consult the **READERS' SERVICE DEPT.** *on pages 77-81*

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PUBLIC WORKS

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The engineering authority in the city-county-state field

Edited by
W. A. HARDENBERGH and A. PRESCOTT FOLWELL

MARCH, 1949

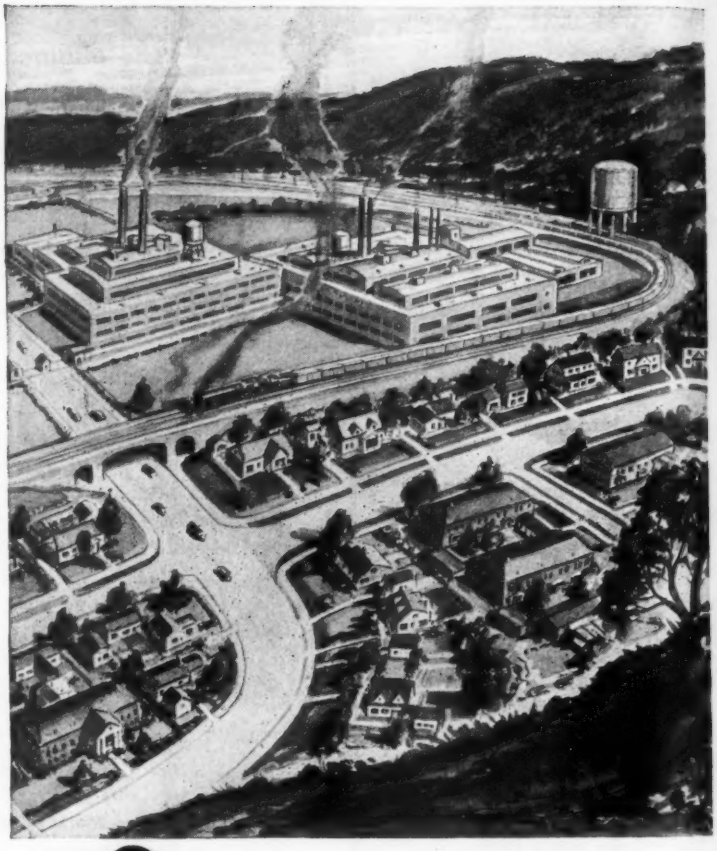
LONGER SERVICE
AT LOWEST COST

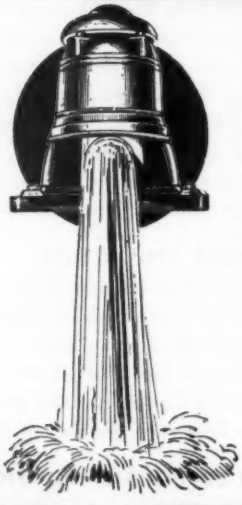
CITIES of all sizes—big and little—the Nation over are buying more and more Layne Well Water Systems and Layne Vertical Turbine Pumps. Here is well water producing equipment that meets every requirement for sustained high efficiency, dependable long life and necessary economy in operation cost.

Layne well water producing equipment has always been designed and built to outlast any other made. The use of finest quality materials throughout, plus rugged strength and manufacturing craftsmanship practically eliminates breakdowns and costly repairs.

Another good advantage is that these systems can and do stand up under severe over-loads. Many are operated as long as six months without a shutdown.

The production from Layne Well Water Systems is often double and sometimes triple that of conventional type wells and pumps. In some cases one Layne Well Water System produces enough water to replace several less efficient systems. The savings thus enjoyed, make the change very profitable.





Layne Vertical Turbine Pumps are available in sizes from 40 to 16,000 gallons per minute. Write for pump catalog.

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When you need special information—consult the **READERS' SERVICE DEPT.** *on pages 77-81*

The Editor's Page

The Problems of Civil Defense

The report recently issued by the Office of Civil Defense is thoughtful and presents a well-worked out overhead organization for civil defense. It presents quite precise information on what should be done and the agency that will do it. There yet remains to be worked out exactly how the city engineer, for instance, will organize the resources at his disposal to meet his probable problems in event of emergency or disaster. The actual methods of doing the work will be much the same as are used in the day-to-day problems of maintaining the essential facilities of a city.

The part that engineers must have in preparing, planning and, if the worst comes, doing the work is a very large one. Our past and current problems of shortages of engineers strongly indicate that, more than ever before, we must learn to use our engineering skills more effectively. One step which may lead to better utilization of engineers is provided in the plan. Sanitary and public health engineers will work under the engineering division and not under the medical division; but that alone is not enough. We must develop new considerations for conserving skills and perhaps even of regulating the kinds of work that engineers will do.

The report is too long to touch on here. Because our readers will be called on under this program to do a major share of the work—if it ever has to be done—we hope that they will get a copy of this 301-page report and study it for themselves.

Highway Business is Big Business

During this year somewhere around 2½ billion dollars will be spent on highway construction and maintenance. That is big business and it ought to be treated as such. It seems to us that there are just a few essentials that would bring better returns on this sum, which is pretty large even for these days. First, we would say, there should be adequate salaries for the men who administer the carrying out of this program. The salaries for highway engineers in all states and in all grades are far too low. Second, we need a broader and more coordinated research program for developing better methods, equipment and materials. Finally, we need to mechanize our road construction and maintenance operations still further.

About 60% of the sum mentioned above will be spent on new construction. That means that our maintenance problems will be bigger next year and every year thereafter. As we build more roads, we have more mileage to maintain, and that costs still more. There is only one way to beat the game. We must develop and use the same kinds of skills that have permitted American industry to develop better and better machines at lower costs. This means research and development and a greater degree of mechanization; and to do that successfully we must have top-notch men and pay them at the normal scale for top-notch men.

Standard Operating Procedures

"SOP" or standard operating procedures were almost as essential to the army as was red tape. In such a large organization, composed of men hastily brought together, utter confusion could have resulted without standard operating procedures which had to be followed without fail. While a certain mediocrity may result, there is assurance that the work will be done passably well.

We believe that standard operating procedures could and should be applied to some or much of our city and county engineering work. Such a procedure as granting permits for, and making and repairing, cuts in pavements would be particularly susceptible to a standard procedure. No doubt many cities already have a detailed written procedure for such work; those that do not would surely find that it would save time, energy, endless instruction and many complaints.

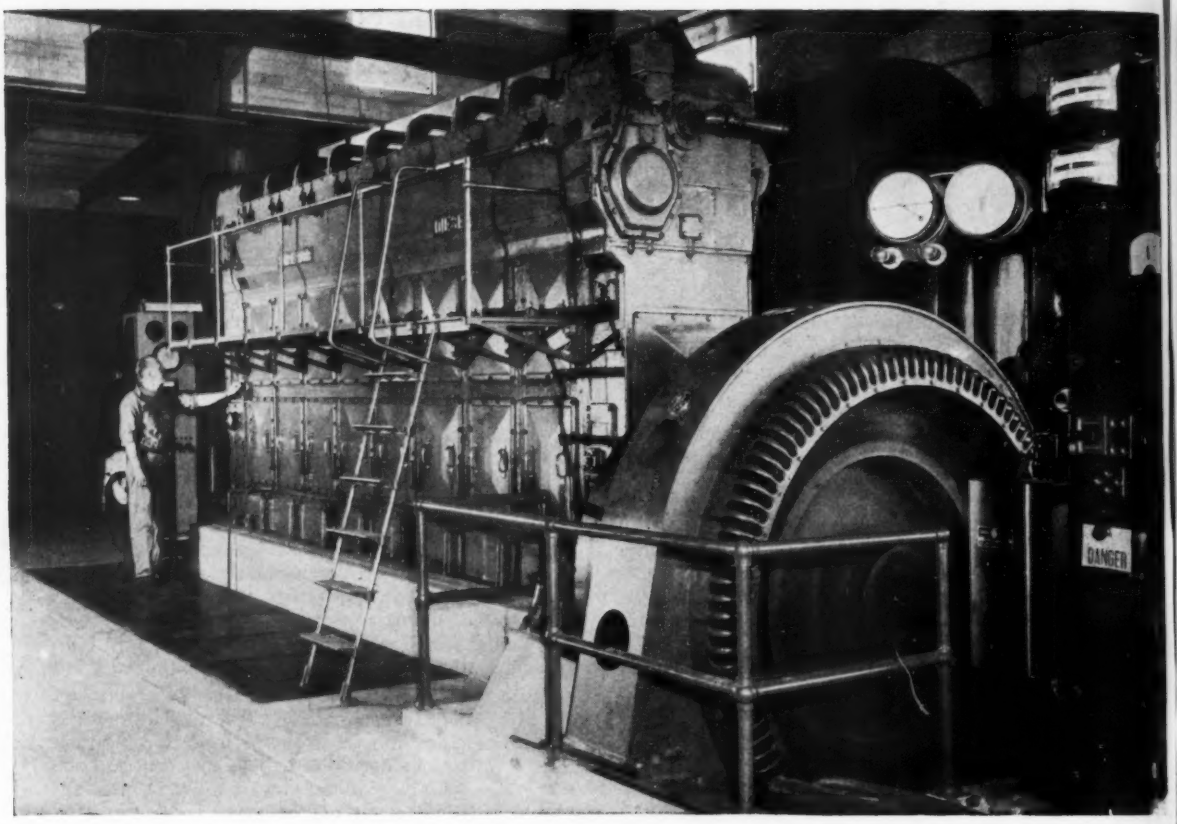
From time to time, we will publish such standard operating procedures so that city and county engineers may write them into the form of fixed specifications for the work to be done. We believe they will be helpful; and we will be glad to have our readers contribute, for the benefit of their neighbor engineers, such procedures as they have found specially useful.

Mutual Aid Extensions Would Be Profitable

Mutual aid, developed during the war as a partial solution to some of the problems of civilian defense, worked well. Many mutual aid agreements are still in effect. For the most part, we believe (for we had no actual contact with civil defense except when blackouts caught us), these are limited primarily to water works. There is no reason why they cannot be extended to include many phases of highway construction and maintenance. Perhaps some communities have done this and, if so, we would be glad to have them tell us about it.

Such agreements might be made between state and county highway departments; between cities and counties; between villages and towns; and between any other communities that face similar problems and use similar equipment and materials. Snow removal equipment would be one phase where mutual aid could be used advantageously, with each kind of plow devoted to the work it is best suited for. Common stock piles of materials; common bituminous storage tanks; the borrowing of specialized equipment, personnel or crews—all these are feasible and should result in better and less costly work.

This idea is not original with us. The data in these paragraphs are based on the excellent paper by J. S. Bright of the Public Roads Administration before the ARBA. It is a sound plan, and we urge early exploration of the areas in which neighboring communities can work together for better and less costly road maintenance.



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An Iowa town is enjoying brighter nights and dependable electrical power because they installed a Superior Diesel. The engine they chose is a supercharged model 80-GX-8. It will deliver dependable power for many years under continuous heavy duty service.

Superior Supercharging provides greater power output from the same engine. This overall increase in mechanical efficiency means lower fuel costs per kilowatt hour at maximum and partial loads. Operation of Superior Supercharging is fully automatic. No control devices are necessary.

One of our field representatives will be glad to show you how a Superior Supercharged Diesel can solve your power problems. Just write and tell us when he can call.

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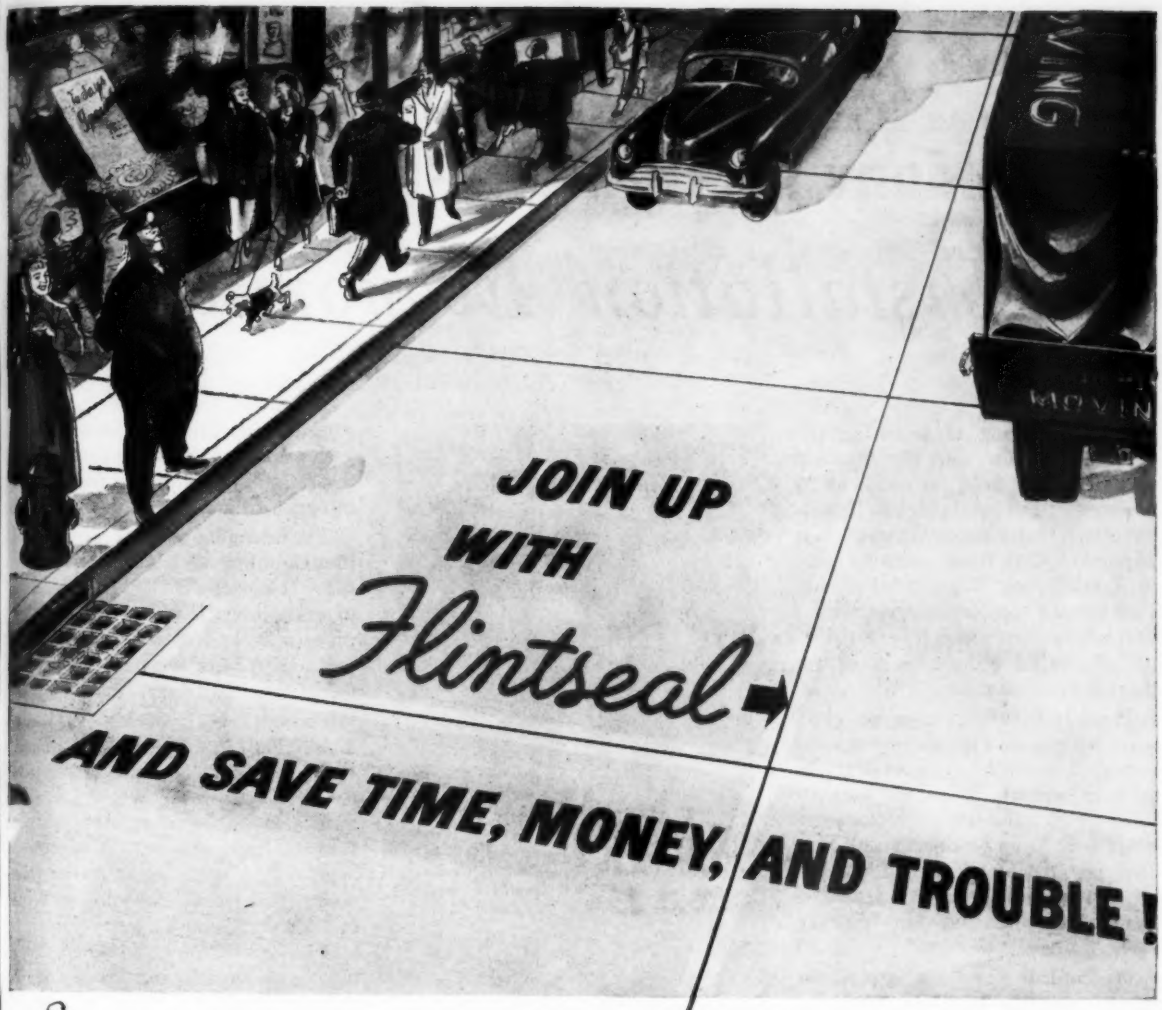

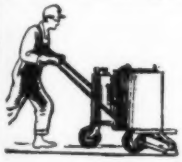

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2) Flintseal adheres to concrete with a tight, lasting bond, effectively sealing out moisture and other foreign matter that wreak havoc between and under the slabs.

3) Flintseal stays resilient. It won't become brittle and crack in coldest weather, nor will it flow on hottest days.

4) Because of this *lasting* resilience and adhesion, Flintseal maintains a tight joint throughout repeated cycles of expansion and contraction of the slabs.

Exceptionally satisfactory for sealing joints and cracks in concrete, Flintseal is finding wide use on municipal pavements, highways, airport runways and many smaller jobs in swimming pools, roofs, platforms and the like.

Get complete information on how joining up with Flintseal can save *you* time, money and trouble...by giving you a fast neat job, and cutting maintenance costs to the bone. Write today for your copy of the free folder illustrated.

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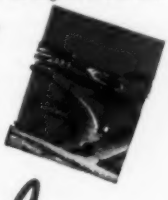

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JOINT-SEALING COMPOUND

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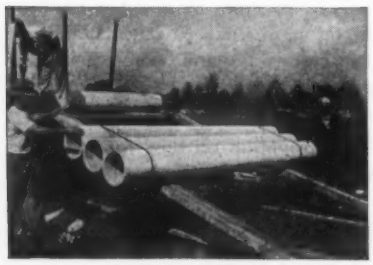
Engineering Facts about
Johns-Manville TRANSITE PRESSURE PIPE
Installation Economies

SINCE the cost of installing the transmission and distribution lines may represent as much as 30 per cent of the total original investment in a water supply system, it is important that these costs be kept to a minimum. Transite* Pressure Pipe offers a combination of installation advantages which have resulted in substantial economies wherever this pipe has been used.

These installation economies start when a Transite Pipe shipment is received. Because Transite is relatively light in weight, unloading and all subsequent handling operations are simplified. More footage can be handled per truckload, trucking costs are lower, and distribution on the job site is easier and more quickly accomplished.

Mechanical handling equipment is not usually necessary except where the larger diameters of pipe are used. The sections of pipe are easily lowered into the trench, either by hand or with the aid of rope slings.



All but the larger diameters of Transite Pipe are unloaded without mechanical equipment and lowered into the trench with slings. Lightness, ease of handling and ready workability contribute to Transite Pressure Pipe's many desirable installation advantages.

In this Transite installation at Long Beach, California, the pipe was laid as fast as the trench was opened. Not more than two newly laid lengths of pipe were ever exposed at one time.

Transite's factory-made Simplex Couplings provide a number of additional installation economies.

Consisting of only three simple parts, this coupling is rapidly assembled to provide a tight, yet flexible joint. A coupling puller is the only tool required for assembly. So rapidly can the pipe be assembled in the trench that the same foreman often supervises both excavation and installation. And this speed of assembly means that trenches need be open only a minimum length of time.

Each joint, moreover, is readily checked for correct assembly as the pipe is laid. This provides advance assurance that the line will meet final test requirements and is a further help in expediting completion of the job.

The flexibility of the Transite Simplex Coupling affords another advantage. It permits deflections up to 5° at each joint, thereby allowing the pipe to be laid around wide curves and across hilly terrain without the use of special fittings.

The workability of this pipe is also a contributing factor to its economy of installation. Transite is adapted to standard water works practice and is readily connected to valves, fittings, hydrants, etc. It is tapped and drilled with standard equipment. The threads are sharp, clean and strong—connections are tight and lasting. Conventional methods are used for making large service connections.

For further details about Transite Pressure Pipe, write Johns-Manville, Box 290, New York 16, N. Y.

Assembling Simplex Couplings is a quick operation. And each joint can be easily checked for proper assembly when it is made, providing advance assurance that the line will meet final test requirements.

JOHNS-MANVILLE JM PRODUCTS

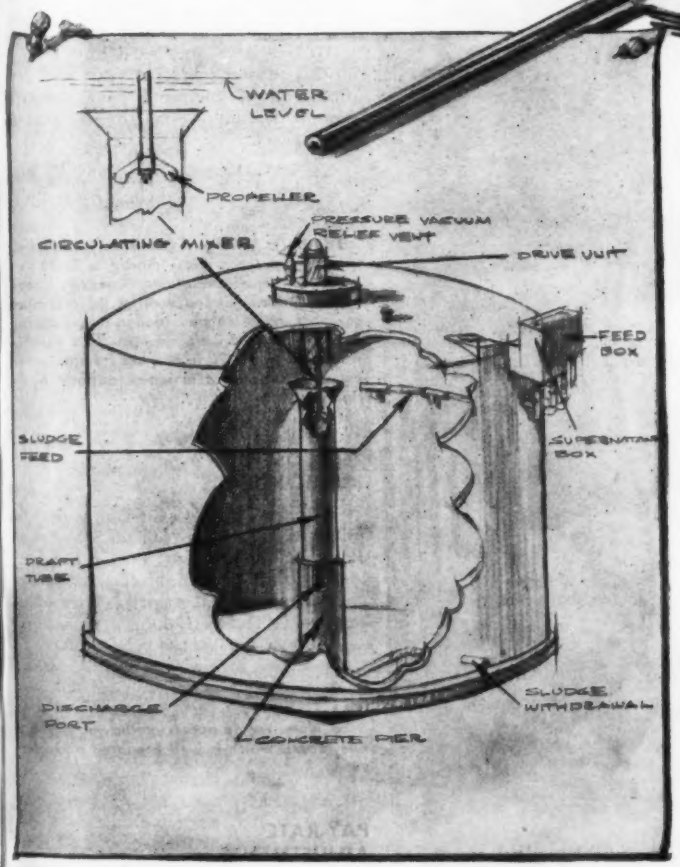
*Transite is a Johns-Manville registered Trade Mark

What does intensive mixing mean in Digester operation?

Here's what Mr. Norman Wagner, Superintendent of the Stamford, Conn. Sewage Treatment Plant reports . . .

TESTS WERE RECENTLY CONDUCTED at the Stamford, Conn., Sewage Treatment Plant to measure the effect of intensive mixing on scum formation in Dorr Digesters. A 50′ dia. Primary Dorr Digester with a fixed steel dome was equipped with a draft tube and high-capacity circulating mixer arranged so that conditions within the tank could be observed. As typified by Mr. Wagner's comment, results were definite and conclusive:

"During testing of Dorr Digester equipped with a high-capacity circulating mixer, we allowed scum to build up for a period of one week. The result was a scum layer a foot thick ...which disappeared after only 60 minutes of mixing."



✓ *Scum formation was positively eliminated. All scum was submerged by mixing action.*

✓ *Action was* rapid . . . *60 minutes to eliminate 1 foot scum layer . . . an hour and a half to turn over entire tank contents.*

✓ *Continuous operation of the mixer was not required.*

✓ *Intermittent operation of the mixer maintained a homogenous sludge mixture.*

The draft tube and circulating mixer demonstrated at Stamford are now standard on Dorr Type M and MA Digesters. Several installations featuring this new development are now being made . . . one of which comprises 18 110′ dia. units, each equipped with 3 mixers. A Dorr engineer will gladly furnish more detailed information on this new and proven development.

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Letters

IRRIGATION FOR INDUSTRIAL WASTES

In Minnesota we have many canneries and the problem of disposal of wastes from plants and silage stacks is causing continuous headaches. For the past year I have been gathering data on land irrigation for such wastes and am encouraged to believe our land conditions are ideal for such a method. Although I read each issue of *Public Works* religiously from cover to cover, I have failed to discover any article treating on this subject, though the *"Food Packer"* within the past year had a long article describing its successful use in Iowa. The past summer, a plant at Watertown, Minn., tried this method and I am advised that, as a result, this method will be installed at several plants this coming year.

If you have published any articles on this subject in recent years will you please advise me as I have complete files of *Public Works* for the past 8 or 10 years.

F. W. McKellip,
City Engineer,
Faribault, Minn.

Ed. Note: We have published a few such articles, but these relate mostly to Texas and other southern installations. However, lagoon treatment has worked well. A list of articles covering irrigation and lagoon treatment has been forwarded. We believe Mr. McKellip would be interested in hearing from our readers with experience in waste disposal by irrigation.

THE COST OF PUBLIC SERVICE

I read with great interest your editorial in the January issue of *Public Works* "The Cost of Public Service" and thought you might like to have a copy of my annual report as City Manager of La Junta, Colo.

Willard S. Conlon,
formerly City Manager,
La Junta, Colo.

Ed. Note: We do appreciate having this very fine report, which is well prepared and interesting.

PAY RATE ADJUSTMENTS

Reference is made to the editorial "Pay Adjustments for Technical and Other Personnel" which appeared in the January issue of *Public Works.* After reading this several times, I am still left with the impression that you are advocating the use "of a decreasing rate of adjustment . . . to higher salaries." I believe this is unfortunate. I agree with you that it is unfair to give a flat dollar increase and limit it to the lower salary brackets. It is my opinion,

however, that it is equally unfortunate to advocate a decreasing rate of adjustment for higher salaries. A "cost of living adjustment" should permit an employee to maintain his standard of living.

In our recent cost of living adjustment, I was able to sell my City Council on the above reasoning and a percentage cost of living was granted across the board.

JOHN S. MORIARTY,
City Manager,
Monterey Park, Calif.

Ed. Note: We regret that the editorial was not clear. This was due in part to an attempt to correct a typographical error and possibly in part to muddy thinking or poor expression. We are fully in agreement with Mr. Moriarty.

WE BLUSH A LITTLE

Your *Public Works* is, in my opinion, the best publication in existence to-day, for the engineer, in that your courageous editorial page and the enlightening and instructive articles are of value to the practitioner, especially those situated distant from the big time. In my thirty years of practice, I have never seen so much valuable information in one place.

R. N. MYERS,
Consulting Engineer,
Pittston, Pa.

Ed. Note: Thank you. With encouragement of that sort we cannot help but keep on trying to make Public Works better.

Sanitary and Highway Engineers Wanted

Highway engineers and highway bridge engineers are needed by the Public Roads Administration and other Federal agencies in Washington and throughout the country. Salaries are $3727 to $5232. Engineering training and experience are required. Further information can be obtained from most first and second class postoffices, from regional offices of *Civil Service Commission*, and from the *Civil Service Commission, Washington 25, D. C.* Applications until further notice.

Competitive examinations for appointment of engineer officers in the regular corps of the U. S. Public Health Service will be held April 11, 12 and 13. Appointments will be made in grades of junior assistant ($3391), Assistant ($3811) and senior assistant ($4489) sanitary engineer. Applicants must have a suitable degree and experience depending on grade applied for. Examinations will be written. Applications must be received before March 18. Write *Surgeon General U. S. Public Health Service, Washington 25, D. C.* Attention: Division of Commissioned Officers. Examinations will be held at various points in the U. S.

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The positively agitated uniform sludge filter in the Permutit Precipitator will save you up to 50% in space and 75% in time of treatment too!

The Permutit Precipitator offers you the newest and most efficient means of removing impurities from your water. It does this by precipitation, adsorption, settling, and upward filtration. Write for full details to the Permutit Company, Dept. PW-3, 330 West 42nd Street, New York 18, N. Y., or to the Permutit Company of Canada, Ltd., Montreal.

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WATER CONDITIONING HEADQUARTERS

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When you need special information—consult the **READERS' SERVICE DEPT.** *on pages 77-81*

How a 3,000,000-Gallon HORTON Ground-Level Reservoir Solved a City's Water Pressure Problem

Before 1947, the city of Alliance, Ohio, had no storage facilities in its water distribution system, except for a small standpipe. Water pressure in the mains depended on pumping pressure from the high lift and booster pumps and, as a result, there was a wide variation in pressure in different areas of the city, and at different hours of the day, as the pumping load varied.

Reservoir Improves Water Pressure

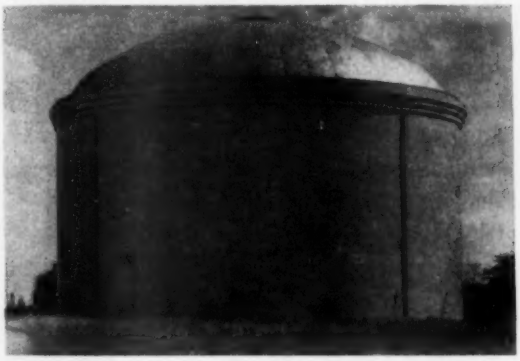
To remedy this situation, a 3,000,000-gal. Horton ground-level reservoir was erected *on high ground* at the southern limits of the city, opposite the pumping station. A reserve supply of water of this kind helps to smooth out pressure fluctuations due to varying demand; bolsters pressure in areas remote from the pumping station; relieves the pumps of peak loads by temporarily storing water pumped during slack periods; helps existing water facilities to meet increased demands; and often justifies lower fire insurance premiums.

Steel Reservoirs Find Wide Use

For these reasons, Horton ground-level reservoirs and Horton elevated tanks are widely used in municipal water improvement programs. The economy of their all-welded steel construction is reflected in original cost, and in low maintenance requirements—usually just a coat of paint applied regularly. Their welded seams remain water tight without caulking, and there is little danger of cracking due to uneven settling.

Horton reservoirs are built in capacities up to 10,000,000 gals., while standard capacity Horton elevated tanks range from 5,000 to 2,000,000 gals. Send our nearest office an outline of your requirements. We shall be glad to furnish estimating figures on request.

Map of the water distribution system serving Alliance, Ohio. 77.7 miles of transmission and distribution mains supply 30,000 people in a 3¾ sq. mi. area.



New 3,000,000-gal. Horton welded steel reservoir, 98 ft. in diam. by 55 ft. high. Note the ellipsoidal roof and ornamental cornice.

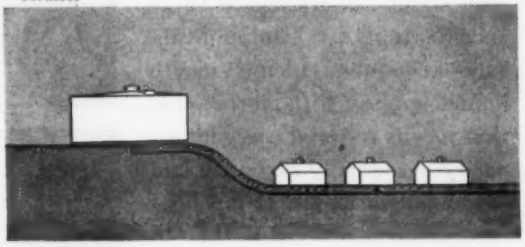
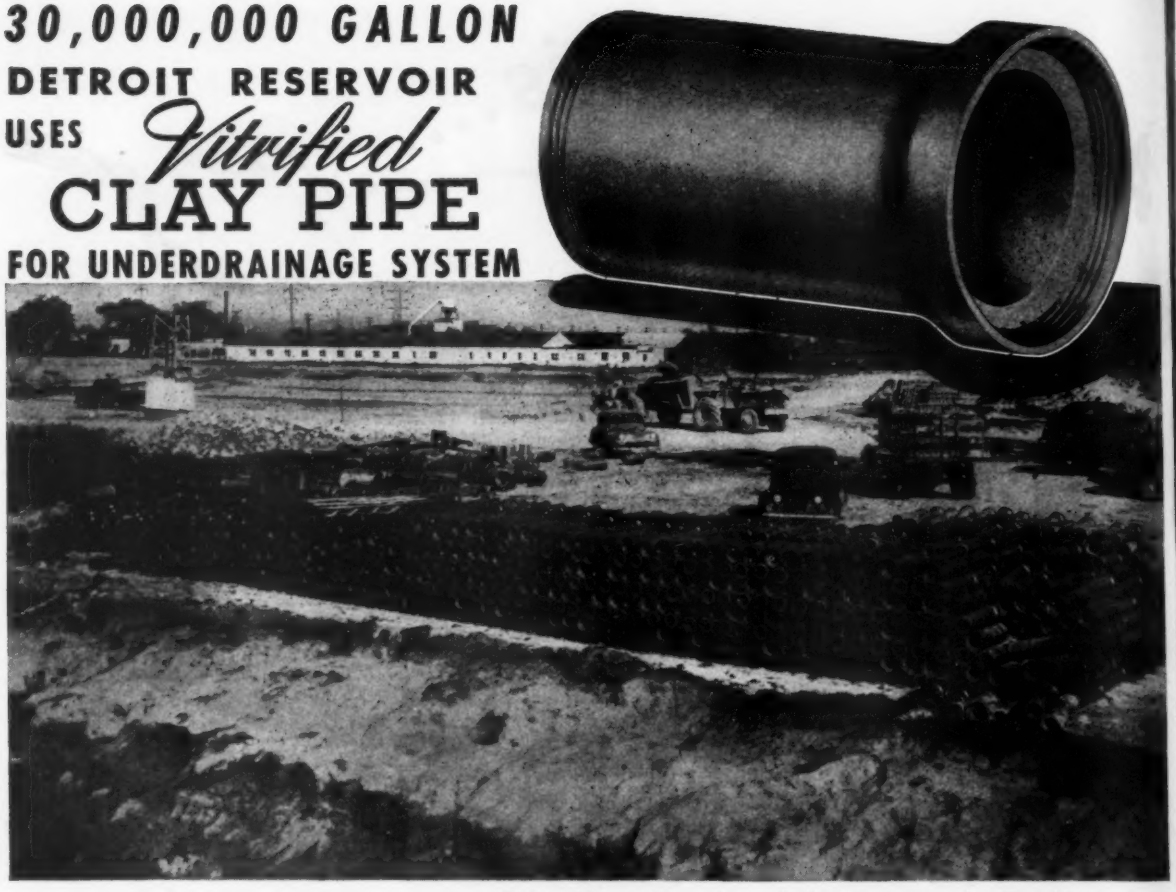


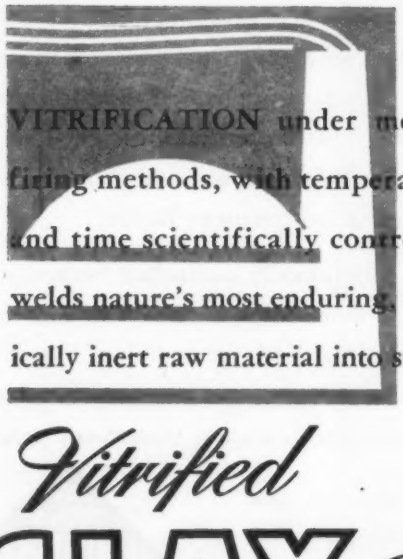
Diagram showing how a ground-level reservoir can be located to improve water pressure in a distribution system.

When you need special information—consult the **READERS' SERVICE DEPT.** *on pages 77-81*

30,000,000 GALLON DETROIT RESERVOIR USES *Vitrified* CLAY PIPE FOR UNDERDRAINAGE SYSTEM



Built without piling, the underdrainage system for Detroit's new Northeast Station Reservoir is designed to prevent floating of the reservoir, which measures 451 ft. by 551 ft. with an average depth of 20 ft. Bryant & Detwiler, Detroit, Mich. — general contractors. Loselle Construction Co., Wyandotte, Mich. — sub-contractors for excavation and for installation of Vitrified Clay Pipe underdrainage.



VITRIFICATION under modern firing methods, with temperatures and time scientifically controlled, welds nature's most enduring, chemically inert raw material into strong, non-corrosive, rust-proof, everlasting Clay Pipe. In no other pipe do you get all the advantages of *complete fusion by fire.* No wonder Vitrified Clay Pipe is universally preferred for sewerage and drainage projects.

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VOL. 80. NO. 3

HOW WILL HIGH COSTS AFFECT THE HIGHWAY PROGRAM?

Richard H. Wilson, Assistant State Highway Engineer,
Henry C. McCarty, Office Engineer,
Richard R. Norton, Assistant Office Engineer
California Division of Highways

THE basic elements of cost of highway construction are (1) materials, (2) wages and (3) equipment rental or ownership cost. Other factors such as overhead, supervision, taxes, insurance and profit are usually proportional to the three basic elements.

An analysis has been made of the more commonly used highway construction materials to determine the average increases applicable to highway construction costs. To determine this average cost increase, the amount of materials required to perform the eight major contract items listed hereafter was compiled. The cost of materials required to perform the work in 1940 and in 1948 was determined and from this it was established that materials in general had increased in August, 1948, to 183% of, or 83% over, the 1940 cost.

The average freight rate increases are those granted by State and Federal regulatory bodies since 1940 and are 144% of, or 44% over, the 1940 rates. Labor costs were investigated from available contractor's labor statistics. These data show that in 1940 the average wage paid for an hour's labor (skilled and unskilled) on California highway construction projects was $1.01. For the first half of 1948 this figure had risen to $2.00, or 98% above the 1940 cost. Overtime paid is taken into account in the labor costs shown but other costs such as subsistence, travel time, taxes, and labor efficiency (or productivity) are not in the curve of hourly labor rates.

The data showing the increase in hourly labor costs do not reflect the true increase in labor costs to the contractors due to the fact that labor productivity is not as great now as it was in 1940.

Labor Productivity

W. D. Shaw, Manager of the Southern California Chapter of the Associated General Contractors of America, in a letter dated September 14, 1948, states that labor productivity is now only 65% as compared to 1940. Other sources, such as the *Engineering News-Record*, estimate this factor at from 60% to 70% compared to 1940.

The continued mechanization of highway construction operations since 1940 has, according to the opinions of various California highway contractors, somewhat offset the decrease in the productivity of individual workmen. In other words, the percentage of unskilled labor to total labor has decreased as a larger proportion of highly skilled labor is utilized as a result of increased mechanization.

To arrive at the true increase in labor costs at the present time a conservative productivity factor of 75% (compared to 1940) has been used. This factor was used rather than 65%, due to the increased mechanization in highway construction. The decrease in productivity since 1940 has been applied to hourly labor costs on a uniformly decreasing basis since 1940 to arrive at the curve of actual labor cost increases.

This article is published in cooperation with California Highways and Public Works.

These data show that labor costs for the first half of 1948 were 264% of, or 164% above, the 1940 cost.

Equipment Cost Increases

The cost of new highway construction equipment has increased to 188% of, or 88% over, the 1940 cost for the United States as a whole, according to Marshall and Stevens of Chicago. (*Engineering News-Record*, May 27, 1948.) Since equipment costs are fairly uniform throughout the country, the national average was used for comparison.

According to the Public Roads Administration, the cost of equipment ownership and operation is now 60% above, or 160% of, the 1940 cost with costs rising sharply as old equipment is being replaced with new equipment at higher prices.

Overall Cost Increases

From the foregoing, an analysis was made showing the overall increase in contractor's costs of performing highway construction in California since 1940. The proportions of 45% for labor, 27% for materials, 23% for equipment and 5% for overhead costs to total costs have been determined from records of recently completed California highway construction projects.

The direct payments to labor on a number of recently completed projects was compiled from notarized labor statistics submitted by the contractors. From these figures, which do not include unemployment and compensation insurance and social security, it was determined that the direct payments to labor averaged 37% of the payments to contractors by the State, though this figure varied from a low of 24% to a high of 44%. These payroll payments were increased by 10% to cover unemployment and compensation insurance,

social security, and other secondary labor costs; and the actual payments to contractors reduced by 10% to allow for the contractor's profit. The ratio of total labor cost (direct labor payments plus 10%) to the contractor's cost (amount paid by the State reduced by 10% contractor's profit) indicated that the labor cost was 45% of the contractor's total cost.

Accurate statistics were available in determination of the 45% labor cost and the 27% material cost. The 23% equipment cost was determined by allowing 5% for overhead cost and assuming the equipment cost was the difference between the sum of these factors and 100%. The relative index numbers of these various construction cost factors are shown in Table I.

CONSTRUCTION COST FACTOR
TABLE I

Item	Per cent of item in total construction cost	Present cost of item compared to (1940 = 100)	Present index of total construction cost (1940 = 100)
Labor	45	264	118.80
Materials	27	183	49.41
Equipment	23	188	43.24
Overhead	5	200	10.00
1948 Contractor's Cost Index			221.45

In the analysis of contractor's costs shown in Table I, the intangible item of materials availability has not been taken into account. Although the term "intangible" is applied to this item, it is a real factor in increasing costs. Any delays in the orderly delivery of materials increases the contractor's cost considerably and this must be taken into account in the preparation of bids. However, because of the impossibility of determining this factor, it has not been given weight in this analysis.

Costs Vs. Bid Prices

Our index shows that contractor's costs have increased 121% over 1940. The next question is: How does this compare with the increase in bid prices for highway work?

From available contract records an index has been computed of highway construction costs determined from amounts paid to contractors for highway work since 1940. The year 1940 has been selected as the base year with an index number of 100. Eight major contract items have been selected as representative of the majority of work on State Highway contracts. In order to give the proper weight to each item, the total quantity of each item for the fiscal year beginning July 1, 1947, and ending June 30, 1948, has been compiled. Following is a list of the eight items and the total quantity for the year ending June 30, 1948:

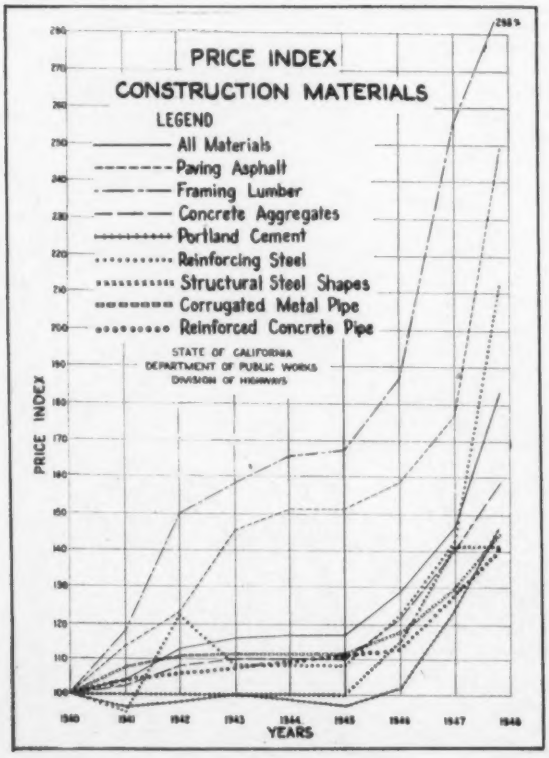
Roadway excavation	*15,697,410 c. y.*
Crusher run base	*681,611 tons*
Plant-mix surfacing	*1,501,178 tons*
Asphalt concrete	*34,060 tons*
PCC pavement	*209,157 c. y.*
Class "A" PCC	*163,760 c. y.*
Reinforcing steel	*27,305,435 lbs.*
Structural steel	*36,413,500 lbs.*

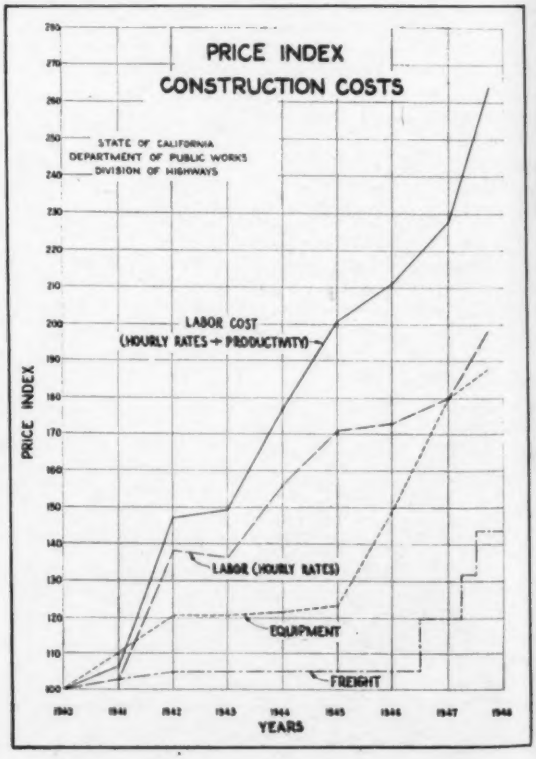
The average bid prices for these items were weighted by determining the total quantity and total cost of each item in each year from 1940 to 1948, and the average weighted bid price determined. This weighted bid price for each item was then multiplied by the total quantity of that item for each full year from 1940 to 1945 and for each half year thereafter. This gave a comparison of the cost of doing the same work in each period since 1940. With 1940 taken as the base year, with an index number of 100, comparative costs for the following periods are as follows:

Year or Half-year	Cost Index
1940	*100.0*
1941	*125.0*
1942	*157.5*
1943	*156.4*
1944	*177.8*
1945	*179.5*
1946 (1st half)	*166.1*
1946 (2nd half)	*193.2*
1947 (first half)	*202.5*
1947 (2nd half)	*204.1*
1948 (first half)	*216.8*

In other words, an average job that cost $100 in 1940 cost $216.80 in the first six months of 1948, or an increase of 116.8 per cent.

It will be noted that the contractor's cost index of 221.45, is 4.65 index points higher than the index of 216.8 representing actual cost to the State. However, with the numerous assumptions which must be made, especially labor productivity, it is not





believed that the small difference has any significance.

The Public Roads Administration "Composite Mile Index" and the *Engineering News-Record* "Construction Cost Index" have been recomputed on the basis of 1940 to show the comparison with the California index. The PRA index, which is based on actual contract prices paid in the United States as a whole, is 210.2 for the first quarter of 1948, and 217.7 for the second quarter of 1948, as compared to the California Index of 216.8 for the first half of 1948. The *Engineering News-Record* index is based on a fixed amount of materials and hours of labor and according to the editors is not adjusted for labor productivity, materials availability or other "intangibles." As would be expected, it is lower than either the California or PRA index, which are based on actual overall costs.

The trend shown by all three of these indices is that costs are increasing at a faster rate than ever before and that the "leveling off" influence that was widely predicted a year or two ago has definitely not materialized.

Why This Increase?

A natural question arises as to the cause of this increase in construction costs. Is the large amount of highway construction now being placed under contract creating an inflationary pressure on the construction market?

On July 1, 1948, there were 507 contractors prequalified by the Division of Highways with a combined bidding capacity of $1,049,000,000 for highway work. On November 1, 1948, there were 283 contracts in force with a combined construction cost for contract work only, not including construction engineers, totalling $88,604,000. The amount of work under contract was only 8.4% of the total bidding capacity. Therefore, lack of available contracting capacity is not a factor in increasing prices.

To illustrate the bidding capacity available, the number of contractors prequalified for various size projects are: $1,000,000 and over, 137; $250,000 to $1,000,000, 187; $125,000 to $250,000, 347; $50,000 to $125,000, 382; Up to $50,000, 507.

The average number of bids received on various sized projects advertised between July 1, 1947, and June 30, 1948 was: Up to $50,000, 4.5; $50,000 to $100,000, 5.2; $100,000 to $250,000, 6.6; $250,000 to $500,000, 7.4; $500,000 to $1,000,000, 7.0; over $1,000,000, 7.4; all projects, 5.6.

From this it can be seen that the general trend is for greater competition on the larger projects than on the smaller projects. This is at variance with the idea that contract prices can be reduced by splitting up large projects into smaller units to give smaller contractors more opportunities to bid.

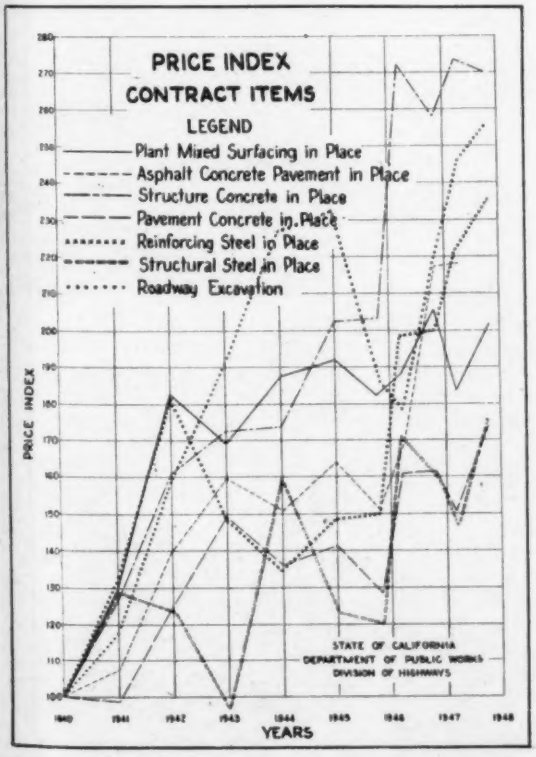
With 137 contractors prequalified to bid on projects of over $1,000,000 and with an average of 7.4 bids received on these large projects, it is evident that the size of projects advertised is not an inflationary factor, but has been, in fact, an influence to keep prices from increasing even more.

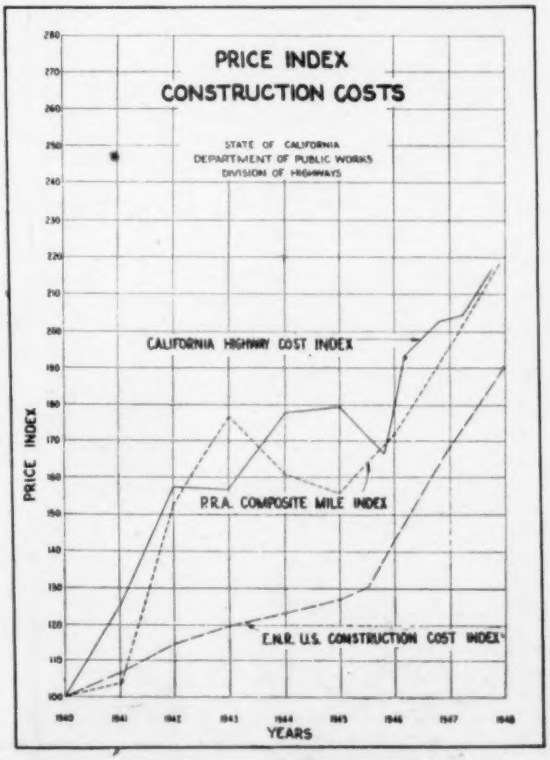
Future Factors

Since the correction of the critical deficiencies in the State Highway System was predicated on a relatively short period of high prices, with a subsequent leveling off, it can be seen that the continuance of the upward trend in construction costs has and will continue to offset gains in revenue, and will make it impossible to modernize the state highway system in step with population and traffic increases. In the July, 1940, issue of *"California Highways and Public Works,"* Fred Grumm, Deputy State Highway Engineer, estimated that the state highway system would require the expenditure of $512,000,000, not including right-of-way costs, to bring it up to modern standards at that time. This figure was based on 1940 design standards and 1940 construction costs.

In 1946 the State Highway Deficiency Report lists the cost of cor-

(Continued on page 60)





Garbage and Refuse Incineration Yields Revenue for Atlanta

H. J. CATES
Chief Engineer, International Incinerator Co.

THE primary object of an incinerator is to subject garbage and other refuse to temperatures sufficiently high to render it to an innocuous state, to reduce to a minimum the possibility of disease epidemics and to reduce the volume to ash and clinker that may be readily disposed of.

While some effort had been made toward heat recovery with the conventional design of plant, it was not until the International Incinerator (Volund Design) was completed and put into operation in Atlanta that this phase of incineration began to demonstrate its importance. After more than seven years of operation it it is increasingly apparent that municipalities should not ignore this important source of revenue.

The City of Atlanta has used incinerators for some sixty years for the destruction of its garbage and refuse and in 1939 it became apparent that the plant then in use had outlived its usefulness. Maintenance costs were increasing, operation was not as efficient as desired, its capacity was too low and labor costs were too high.

Results of Refuse Analysis

Consulting engineers were engaged to study and make recommendations as to the city's needs. First, exhaustive studies of the garbage and refuse were completed to determine its makeup, its heating value and moisture content. To make the determinations, the refuse was divided into ten parts—paper, animal matter, bread, wood, rags, vegetable matter, glass, metal, #1 screen and #2 screen. The analysis was made for a period of one year from representative samples from 93,870 tons of refuse. The results were as follows:

Paper constituted 26.32% of the total or 24,706 tons; animal matter (meat bones, etc.), 1.60% or 1,503 tons; bread, 1.00% or 939 tons; wood, 1.59% or 1,502 tons; vegetable matter, 19.66% or 18,455 tons; rags, 2.68% or 2,516 tons; glass, 3.83% or 3,595 tons; metal, largely tin cans, 5.40% or 5,069 tons; #1 screen, consisting of hard clinker, rock, lumps of coal and the like, 10.70% or 10,044 tons; #2 screen, any material that would pass through a ½ inch mesh screen such as, dirt, fine ash, small bits of paper, etc., 27.22% or 25,551 tons.

To determine the moisture content, three samples of 100 pounds each per day were put into bags and hung up in the plant and left until they stopped losing weight. The loss of weight was taken as the moisture content.

To determine the heating value, an equal amount of all of the samples analyzed during each month was prepared, dried and then ground to pass through a 30-mesh screen. The samples were then sent to the Georgia Institute of Technology, where the btu values per pound were determined. These showed the following results:

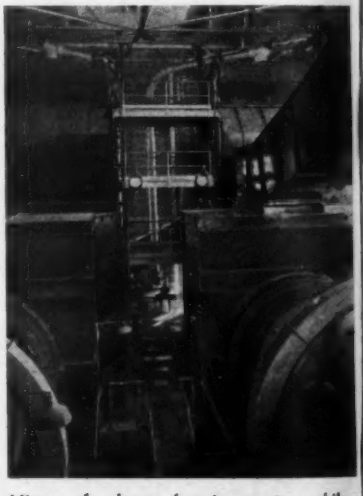
Heating value on a dry basis was found to be 7086 btu per pound for the high month and 6250 btu per pound for the low month, with an average of 6668 btu, or about half the heating value of good coal.

On a wet, or as fired, basis, there was a very definite change in the results. This showed a high of 4761 btu per pound when containing 20.92% moisture and a low of 2322 btu per pound with 58.98% moisture, indicating clearly that the most important factor to deal with is moisture.

An extensive survey of the various systems used in the United States indicated that all used substantially the same design. Most of them appeared uneconomical, with little or no heat or metal recovery. Failing to find a satisfactory American incinerator, the study was extended to Europe where a method was found that had proven very satisfactory in several European countries. The system had been originated and developed in Denmark by the Volund Company of Copenhagen. A study of the design indicated that when adapted to American requirements, it would be an efficient garbage destructor, as well as an excellent steam producer; would be flexible in operation to meet the varying needs and conditions encountered in burning garbage; and would also allow the recovery of metal after it had passed through the plant. All of these are factors in economical and profitable operation.

How the Plant Operates

A brief description of the operation of this plant is as follows: First,



View of plant showing rotary kilns, combustion chamber and boilers in background.

garbage is transferred from the dumping pit to the charging hopper by means of cranes and grab buckets. From the charging hopper it moves in a continuous stream into the drying chamber. No excess air, which would upset the burning process later on, is admitted to the unit at this point. The original designers recognized the importance of moisture and incorporated the drying chamber as an integral part of the unit. Drying is accomplished by passing part of the hot gases from the ignition chamber over the incoming garbage,

the gases used for drying then being conducted to the main combustion chamber by means of an overhead by-pass.

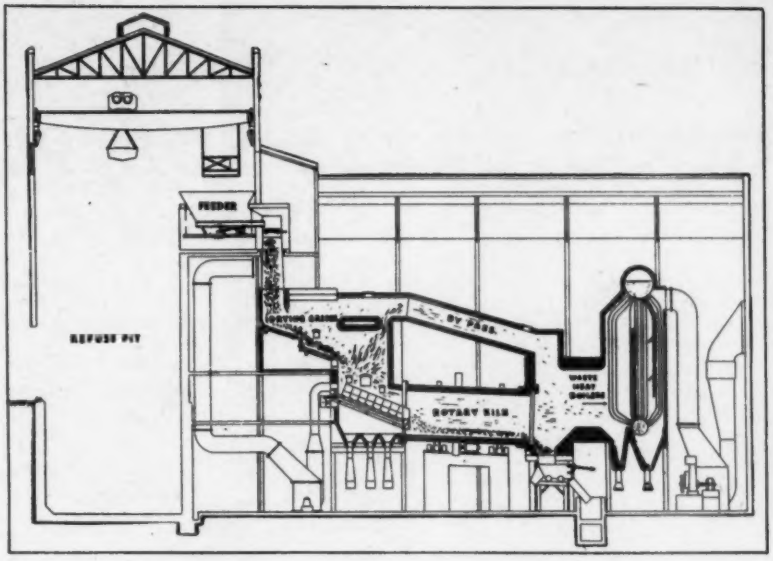
Electrically driven reciprocating grates move the garbage from the drying chamber into the ignition chamber where pre-heated air is admitted to the fuel bed. Air to support combustion is supplied by a forced draft fan that forces air through a pre-heater which is built into and forms a part of the furnace wall. The volume of air is automatically controlled to meet combustion requirements.

Again by means of electrically driven reciprocating grates, the burning garbage is moved into a slowly revolving rotary kiln, which keeps it in continuous motion and subjected to the streams of hot gases passing through the kiln. By the time it reaches the dumping zone at the end of the kiln, combustion has been completed.

At the dumping zone, clinker, ash and tin cans are discharged onto a slow moving conveyor that is submerged in water to quench completely the residue on its way outside the building. It is at this point that metal separation takes place. From the conveyor the residue is discharged into a rotary screen that separates the metal from the clinker. The metal is then conveyed to a collection bin from which it is rolled flat and shipped. The clinker is loaded on trucks and is used as a sub-base for streets, for surfacing parking lots, filling holes, etc.

Gases pass into a combustion chamber at the end of the kiln, where they are mixed with gas from the overhead by-pass where combustion is completed. From the combustion chamber the hot gases (1800° to 2000°) then pass through a vertical boiler of waste heat design. To control the flow of gas an induced draft fan is provided, the speed of which is under control of the operator at the control board. From the boiler the gas may be passed through a dust collector before going to the stack.

The Atlanta incinerator.



Section through incinerator showing essential parts.

Advantages

The advantages of Atlanta's International Incinerator include the following: (1) Low unit cost of construction due to the capacity of the units, which may be designed to burn from 85 tons up to 250 tons per unit per twenty-four hours, thus reducing to a minimum the number of units required for a given capacity.

(2) The process is continuous, all operations throughout the unit are mechanical and under control of an operator from a centrally located control board. This reduces to a minimum the labor requirements, and eliminates entire hand stoking.

(3) Since garbage is introduced into the unit continuously, excess air at this point is eliminated, making it possible to admit air automatically in the proper volume to support combustion and to insure constant temperatures of the gases. This produces uniform steam pressures and flows that may be economically used for the production of power, an important source of revenue. The continuous operation prevents the forming of large clinkers, thus making the separation of metal a comparatively simple and inexpensive operation, as well as producing a more uniform product. Here, again, is an important source of revenue.

(4) The revenue produced from the sale of steam and metal will amortize the entire cost of the installation in a comparatively short period of years.

Incineration need not be a financial burden to a city since refuse and garbage, like any other fuel, contains a definite heating value, and with a properly designed and operated plant the heat can be turned into an important cash revenue. Atlanta's case is an example.

In 1939 the City of Atlanta issued and sold revenue certificates to finance the construction of their International Incinerator. The bonds were twenty-year serials and the revenue derived from the sale of steam and metal was to be used to amortize its cost. The plant was completed in September, 1941, and was in full operation by the end of that year. From January, 1942, to October, 1948—six and three-fourths years of operation—the revenue has amounted to just $15,422 less than the original cost of the plant. The revenue for the year 1948 based on actual figures for the first nine months is $117,157. During the period from 1941 through September, 1948, actual flow meter records and scale weights, without allowance for losses of any kind, such as pit drainage and steam losses, show the following results:

Total refuse and garbage burned—628,322 tons.

Total steam generated—1,962,386,830 pounds.

Total steam sold—1,616,538,590 pounds.

Total steam used by plant auxiliaries—345,875,340 pounds.

On a basis of 8 pounds of steam per pound of coal, the total of 1,962,386,830 pounds of steam from refuse and garbage is equivalent to 122,649 tons of coal.

How to get
GOOD GRASS FOR PUBLIC PLAY

J. W. LENTZ
O. M. Scott & Sons Co., Marysville, Ohio

The first of two articles on fundamental and essential factors in soil preparation, the use of fertilizer and the selection of seed. The second article will cover the problems of grassing highway berms, shoulders and slopes.

GRASS areas that will stand up under public punishment and come back again for more have long been the goal of park and school officials and their maintenance men. Herein will be found a discussion of the fundamentals and essential factors in soil preparation, the use of fertilizer and the selection of seed necessary to fulfill the needs of special turf.

Utility is the number one requirement of permanent turf for sports, play, picnics and parks. Too often such lawn areas are planned for beauty rather than utility. Actually these grass turf areas are more apt to receive gruelling traffic than highway shoulders where erosion prevention and good appearance are the more important factors.

Park Lawns—Grass in parks should be planned for moderate foot traffic. The sod bordering bridle paths and foot trails serves the same purposes as the shoulder seeding along a highway. In these cases safety, through erosion prevention and dust control, is of prime importance and good grass is the answer.

Recreation Fields—Ball diamonds, touch football fields, archery courts, bowling greens, golf courses and driving ranges constitute the various uses to which good sports turf may be placed by municipalities. Such turf must withstand heavy traffic and hard usage, and must make a presentable appearance many months out of the year.

Picnic Groves—Lawns in picnic areas must be wear-resistant and should be weedfree. Such areas especially should be free of ivy, ragweed and similarly irritating pests. Picnic groves, like sports fields, must be selected so that they may be readily drained and quick drying. A successful turf in picnic areas will control the dust, absorb the rain and withstand hard use.

If a turf is to prove useful in the job for which it is planted, correct soil preparation is essential. In developing grass for public use, oftentimes soil preparation is overlooked or slighted because it seems unnecessary or impossible to do otherwise. There is little need of investing in clearing and grading an area for lawn development unless the foundation of that lawn—the topsoil—is prepared properly to insure a quick, uniform start. The same preparation will mean healthy, deep roots as the sod develops.

Seed bed preparation should follow the installation of subsurface drainage systems. The proper development of a seed bed involves plowing, discing, dragging and grading with power and hand tools. Cultivation should be thorough to a depth of at least 6 inches so that the topsoil is blended into the soil beneath rather than left as a distinct veneer on the surface. All cultivating tools should be used at this point with the thought of avoiding layering of different soil types in the zone later to be occupied by the grass roots. Following cultivation with plows and discs, drags capable of being weighted by various amounts should be pulled behind a light-weight tractor.

Soil preparation should be as thorough as soil moisture conditions will permit. When a soil of a rather heavy texture such as a clay or clay loam is wet, cultivation and dragging should be avoided. Otherwise the natural structure of the soil is impaired and its productivity hampered. The summer months or early fall provide ideal conditions for grading and soil preparation. During those periods the soil is usually dry enough to be worked without harm. The grading may then be followed up without hurrying at the expense of thoroughness by planting during the most favorable season of early fall.

Fertilization

Every bit as important as proper seed bed preparation is the use of plenty of the right turf fertilizer. Its make-up should be part organic and it should be complete, containing all three of the essential nutrient elements: Nitrogen, Phosphorus and Potash.

Good fertilizer formulas for turf purposes, both for starting new grass and for the maintenance of established sod are 10-6-4, 9-8-3, 8-7-3

A well-grassed picnic grove.

and 5-10-5. The first figure represents the percentage of Nitrogen, the second figure the percentage of Phosphorus and the third figure the percentage of available Potash in the formula. Which formula is specified or selected and the amount applied will depend largely upon the natural fertility of the soil and the previous treatment it has received. Usually an application of between 400 and 800 pounds per acre is advisable.

The fertilizer may be broadcast or drilled in with a regular fertilizer drill. Following the distribution of the fertilizer, the area should be dragged from several different angles to smooth the surface and further incorporate the fertilizer with the seed bed.

Lime, while not a fertilizer, is recommended for use if a soil test indicates the soil reaction to be out of range for good grass development. The most desirable soil reaction for successful turf falls between pH 6.5 and pH 7.0. A usable range for grass is between pH 6.2 and pH 7.8. Soil reaction alone does not determine the need for lime. Other lime requirement tests should be coupled with pH determination before a final decision is reached as to the quantities of needed lime. The practical time to make this soil amendment is just previous to the fertilizer application and before seeding.

Seeding

While the selection of seed alone is not the complete answer, unless proper soil preparation, liming and fertilization has come before, care in selecting the seed mixture to fit the type of turf desired in each situation can not be over-emphasized. If pains are taken to carry out these initial steps, it is all the more important that the correct blend of grass varieties is chosen to complete the project. Mixtures of several grass seed varieties are, without exception, more satisfactory than the use of a single variety. So far there is no one grass that is capable of remaining its best throughout the entire year. Each variety in a mixture is placed there for a specific purpose and the end result is a permanent turf capable of providing useful service throughout the greatest portion of the year.

A special blend of grass seed that will develop into traffic tolerant turf should receive priority attention. There are such mixtures proven best by alert seedsmen for parks, lawns, sports fields and picnic areas under shade and on slopes. Those who recommend special mixtures based on research and previous experience of others do so because they know their recommendations will produce the best results. Otherwise they could not long promote the sale of these grass seed blends. Their recommendations are worthy of careful consideration and study.

Legumes such as clover and alsike are undesirable in the planting of sports or play areas because they produce slippery foliage. Alta Fescue, a relatively new improved strain of Meadow Fescue, is proving quite successful in the planting of play areas and sports fields. Also in the permanent, tough category are Chewings Fescue, Creeping Red Fescue and Perennial Ryegrass.

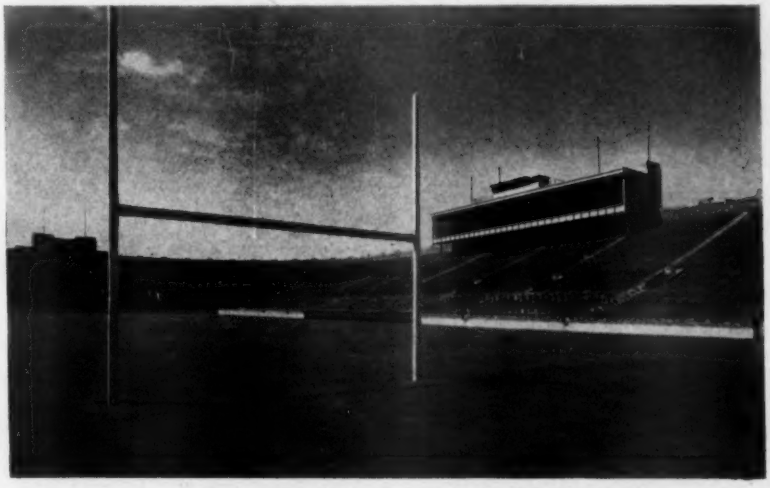
In small areas the methods of getting the grass seed into the seed bed involve broadcasting by hand, the use of a wheelbarrow seeder or other hand operated mechanical seeding devices. Larger areas may best be handled by using a wheat, small grain or fertilizer drill to which simple alterations or adjustments may be made so that the tiny grass seeds may be handled effectively.

Many times planting is done directly on a "cultipacked" surface. A farm implement leaves the seed bed in a corrugated condition which has the effect of conserving moisture if the rainfall is limited. Also, the loss of seed is reduced when the rainfall following seeding is overabundant. Much seed is saved when hot, drying winds follow the planting on a seed bed prepared with a cultipacker. This method results in the saving of the considerable labor necessary when areas are raked by hand after seeding.

Whatever method is used, the seed should be kept within the upper quarter-inch of the surface so as not to retard germination. Grass seed may be planted much deeper than the surface quarter-inch and still grow, but germination is retarded considerably and in the meantime serious erosion may take place and troublesome weeds are apt to get started.

Special Turf Problems

The demands on public play areas are exacting. In addition to a high degree of wear-resistance, parks, playgrounds and picnic lawns present special grass growing problems of drainage, shade and slopes.



Turf on the Notre Dame football field.

Drainage—Correct drainage is all important in the installation of sports fields and picnic areas. Each drainage installation is an individual problem depending on the lay of the land, the type of soil and the availability of facilities for removal of surface and subsurface water. It would be advisable to seek the services of a drainage engineer if the area involves considerable acreage and has poor natural drainage. Drainage promotes the growth of more durable, strongly rooted sod and reduces the possibility of standing water, making areas available for play more days throughout the year.

Shade—Picnic areas and park lawns beneath trees require the use of special grass seed combinations. Of equal importance is correct feeding. This is necessary to provide extra nourishment so that the grass may compete successfully with the trees whose hungry roots share the same topsoil. By combining the use of shade tolerant grass varieties such as Chewings Fescue, Creeping Red Fescue and Perennial Ryegrass with a plentiful supply of the right turf fertilizer, a traffic tolerant sod may be developed.

Slopes—In grading public lawn areas it is well to keep in mind that the slopes should be maintained as gradual as native terrain will allow. Gradual slopes with a rise of one foot in four offer more possibilities for use when properly planted. On the other hand very steep slopes involving a rise of 1 foot in 2 or 3 feet require more expensive maintenance methods, adding to upkeep expense through the years.

Water, sewage treatment and power plant installations often involve dikes, slopes or embankments of grades having a 1 foot rise in 2 feet. Such severe slopes need well adapted seed mixtures to stop erosion permanently On steep slopes legumes like clover, alsike and vetch are included in the mixture with Kentucky Bluegrass, Ryegrass and Alta Fescue. The degree of slopes or the degree of shade as well as the anticipated amount of traffic these areas are expected to carry are the factors determining the final make-up of the seed mixtures to be planted.

New seedings in these areas will be more successful if a scant protective covering of straw is used until the new grass gets under way. When a light scattering of straw is employed, a generous application of high nitrogen fertilizer must be used to help replenish the soil nitrogen consumed by the particular bacteria that break down or decompose the straw. Mulching wtih straw or hay without supplying plenty of nitrogen fertilizer will likely do more harm than good in the long run.

For this reason mulching applied during a winter seeding or as a protection during mid-summer should be removed by using rakes and chay forks upon the arrival of the ideal growing weather in early spring or early September. The newly started grass will actually make better progress on its own without the straw cover during those periods.

If the bulk of the litter is allowed to remain in place during the more favorable growing seasons the mulch is quite apt to counteract any benefit it may have given the grass earlier. In this case the good judgment of the project superintendent and the man on the job plays a most important part in the success of the planting.

Maintenance, Care and Repair

Mowing—The maintenance practice that consumes, by far, the largest share of the budget in connection with public turf care is mowing or grass cutting. Often too much emphasis is placed on the frequency of mowing and not enough thought is given to how the cutting is done. This accounts for waste of labor and money. The popular practice calling for "cutting close and as often as possible' makes mowing a problem rather than a normal maintenance function.

On the other hand the height of cutting is definitely more important than the frequency of shearing the grass. High cutting, between the heights of 2 and 3 inches, is one of the secrets of successful public lawns for public play. The reasons for this cutting height are well founded and are based on years of experience. It leads to a deeper rooted sod that is naturally more drouth resistant. The heavier topgrowth resulting makes for better appearance. Such turf is capable of more rugged service.

Turf at Old River Park, Dayton, Ohio.

Weed Control—Many times mowing is done only to cut down the weeds. There is a more efficient and effective method of accomplishing the same results with much less expense for gasoline, labor and wear and tear on mowing machinery. In recent years easy methods of weed control which may be practiced annually destroy ragweed, poison ivy and other offensive plants before their flowering and seeding period. Weed controls involving the use of 2,4-d compounds may be handled by spray methods. Recently a popular dry compound has been prepared that destroys broad leaved weeds in park lawns while the same application supplies an effective source of fertilizer.

Park lawns, recreation fields and roadside picnic groves require very little cutting after a single application of weed control. The tall, rank growing weeds are stunted if not destroyed entirely, resulting in a considerable saving on the mowing side of the ledger.

Feeding—Another secret to low maintenance cost and better all around results is regular fertilization. Applications of specially prepared turf fertilizer made regularly each spring and fall will keep a well planned and properly planted turf in rugged condition for hard public use. Liming of established areas in certain localities when needed will also lead to better results.

Repairs—Renovating badly worn sod involves reseeding the bare spots and scars as they appear. The soil is loosened first by vigorous raking, then brought up to correct level by the addition of fresh topsoil before fertilizing, seeding and rolling lightly. Turf for recreational purposes should be rolled lightly at the beginning of each spring after the frost has left the ground and the surface has become partially dry.

Where available, ample quantities of water applied during periods of temporary drouth will help the grass recover from heavy use. Early signs of moisture deficiency should be recognized and corrected by supplying water evenly and adequately.

Summary

After careful preparation of the seed bed, following engineered grading and drainage, grass seed should be used which is made up of varieties especially adapted for the situation at hand.

Grass is a crop and should be planted and maintained as such. Grass for special purposes requires special but not necessarily expensive or elaborate handling.

Tacoma Brings in RECORD WATER WELL

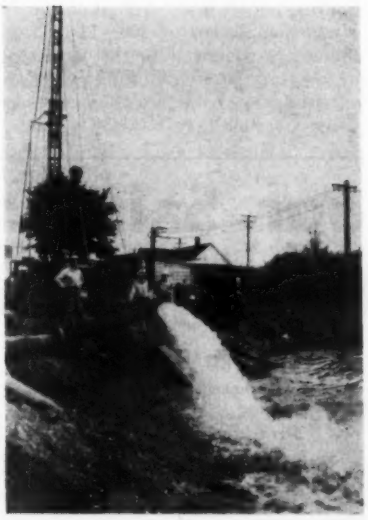
A. R. MacPHERSON

WITH a conservatively estimated flow of 11 mgd., the city of Tacoma, Wash., recently struck it rich in its latest water well. This was drilled in the South Tacoma area where 8 other producing wells are spaced over a distance of 2 miles. Designated as No. 11-A, the new well produces approximately one-third as much water as is produced by all the other 8 wells. According to John W. Robinson, city ground water geologist, it is the biggest producing well ever uncovered in western Washington. Only in Spokane, where the city has sunk wells into a subterranean river, is there a heavier flowing well in the state.

Work of City Crew Saves Money

The city of Tacoma is congratulating itself that city forces conducted the drilling of this particular well although the entire job was supervised by L. B. Richardson, owner and manager of the Richardson Well Drilling Co. of Tacoma.. The city had just purchased a new drilling rig, a mobile Speed Star, equipped with a 6-cyl. Continental motor. All were anxious to see just how the new rig would operate, and were elated at the fine performance of the machine in its initial operation of bringing in a record producer. In view of the fact that a private contractor customarily is allowed a substantial bonus on the quantity of water produced above a certain minimum, the city is also elated that such a bonus was saved in this case. Some contractor might well have been well financed had he been fortunate enough to have struck the highly productive strata tapped by the city crew.

Supt. W. A. Kunigk of the Tacoma water department estimated that the city's well system is now capable of producing 36,565 gpm., or approximately 52 mgd. Addition of the new well will care for Tacoma's growing needs under normal demands for several years to come. Wtih the help of its recently rebuilt gravity steel pipe line bringing water to the city from Green river, its maximum summer needs of approximately 100 mgd. are now assured.



Testing Tacoma's new well. Star drilling rig at left background.

Unusual Water-Bearing Strata

An interesting feature of the new well is the fact that only 225 ft. away well No. 6-A, drilled several years ago to greater depth, produces only 4.5 mgd. with a top record of 5,900 gpm. On tests of flow of the new No. 11-A well using a Pomona pump, long runs with a draw down of 22 ft. under continuous pumping produced no apparent drawdown effect on the nearby No. 6-A well, which, like all the other city wells, is designed for a 60-ft. draw down.

Mr. Kunigk stated that layers of earth in this area were dropped in a very disorderly manner by glaciers during the ice age. Consequently, a water-bearing stratum might be at one depth in a certain spot and be many feet deeper, or even blanked off, a comparatively short distance away. Mr. Robinson, who was formerly of the staff of the water resources branch of the U.S. Geological Survey, selected the site for the well. Location methods worked out by the Geological Survey were employed. In this case the results were more than satisfactory, although the best proven methods are considered more or less of a gamble to skeptical, old-time drillers.

Owing to the large scale operations of drilling the big well it was found necessary to use some unusual methods for constructing and protecting the work as drilling got under way. Instead of employing the usual timber cribbing for supporting the well as it was drilled, Mr. Richardson dug a pit 25 ft deep with a one-yard clam-shovel. In this pit he secured four 12-inch iron girders 16 ft. long. These were placed to form a rectangle around the well, the beams were secured with two anchor holds, one each on opposite sides, and two 50-ton jacks secured between the other two sides of the rectangle.

The wisdom of this procedure was proven by the fact that drilling operations proceeded for the entire 30 days of daylight drilling with scarcely a hitch of any kind and without any of the usual delays which might well have been expected in a large operation of this kind. Careful use of the big jacks enabled the engineers to retrieve all the valuable 52-inch and 42-inch steel pipe used in the well. Since steel pipe of this size is very difficult, if not impossible, to obtain, the city engineers considered the salvage operation of great value as the pipe can be used for future drilling jobs.

Drilling Operations

Initial drilling of the well began with the use of 6-ft. lengths of 52-inch steel pipe which were jointed by welding as the pipe was driven down. At a depth of 40 feet the 52-inch pipe was replaced with 42-inch pipe. Interspaces were filled with concrete grout and the 52-inch pipe was pulled to the surface. The 42-inch pipe was driven to a depth of 85 feet and replaced by similar operations with 36-inch pipe, after which the 42-inch pipe was pulled up to the surface. About 400 sacks of cement were used for building the concrete grout seal.

The big flow of water was encountered at a depth of 115 feet. The engineers then lowered the final and permanent length of 26-inch steel pipe to the bottom of the well. The 36-inch pipe was raised far enough to allow installation of a 20-ft. bronze screen secured to the bottom of the 26" pipe. Mr. Kunigk stated that while this particular type of screen is expensive, it was well worth the investment as it will last as long as the well gives water.

Following pump testing operations with the Pomona unit temporarily installed, the well was capped to await purchase and installation of a permanent pump. Bids have been called for a pump of 8,000 gpm. capacity, and until this has been purchased the total cost of drilling the well cannot be determined.

Principals on the well crew included Geologist J. W. Robinson; L. B. Richardson, head driller; P. Wilcox, assistant driller; J. Prokop, welder and J. G. Eernisse, mechanical engineer.

Mr. Richardson attributed much of the quick success of the project to the fine performance of the city's new Speed Star rig, which he stated had weathered its initial tough workout with amazing ease in continuous drilling operation without a hitch. Upon completion of No. 11-A well the rig was moved to the west end of the city atop a hill on which is situated one of the city's water reservoirs. A small test well is being drilled alongside the reservoir. This is the first time the city has prospected in this area for water. Mr. Richardson is also supervising this job and states that they will go down to a depth of 300 feet if necessary. If no satisfactory flow of water is encountered the rig will be moved back to the South Tacoma area again.

Although the city now has a plentiful supply of water, its storage reservoir capacity is considered as inadequate to meet any large sudden or continued emergency demands. To take care of such a contingency the city will continue to drill for more good producing wells which can then be used as stand-by sources of water supply to meet any future or unforeseen demands that may arise.

Earning Your Salary by Better Management

CLIFFORD M. PARRISH
Graduate student, University of Illinois

IN the "Manual of Water Works Accounting"[1] published jointly by the municipal Finance officers Association and the American Water Works Association we find a definition of accounting as it is applied to the water works field.

> "A good accounting system is one which provides for recording financial data in such manner that they can be utilized effectively as a guide in managing the utility plant, as a basis for determining the fidelity of persons administering water works funds, and as a means of informing public service commissions, creditors, stockholders, municipalities, and customers of the utility's financial condition operations."

The water works superintendent or manager might well ask himself, "In just what way will accounting assist me in the operation of my plant?" Before answering the question, he must realize that experiences and records of expenses found in the financial statements of previous years are the bases generally used in the preparation of the yearly budget. Therefore, department heads must know the cost of carrying on the particular phases of operation that are under their supervision. Another principal purpose of cost accounting is to provide data whereby the efficiency of operations can be judged by comparison with costs at other plants.

Standards of Efficiency

According to Louis R. Howson the following may be used as a basis or standard by which the efficiency of plant operation may be judged:[2]

(1) There should be one employee for each 800 to 1,200 population for plants serving a population of about 25,000. For cities with a population of one million or over, there will be one employee for each 1,500 to 2,000 population.

(2) Revenues should range from $5.00 to $7.00 per capita per year except in arid sections.

(3) Operating expenses other than depreciation will average approximately $2 per capita per year with a range of $1.25 to $3.

(4) Investment in the plant will average $70 per capita and depreciation $0.75 per capita for privately owned plants and $1.25 for municipally owned plants where the retirement reserve is largely utilized for new construction.

(5) Meter reading will average from 5¢ to 7¢ per meter.

(6) Hydrant repairs average $1.75 to $4 per hydrant.

The costs of filtration, sedimentation, chemicals, etc., were not stated. The wide divergences in the quality of the raw water and the treatment given make it impossible to determine the average costs of such items. The relative cost of pumping may be de-

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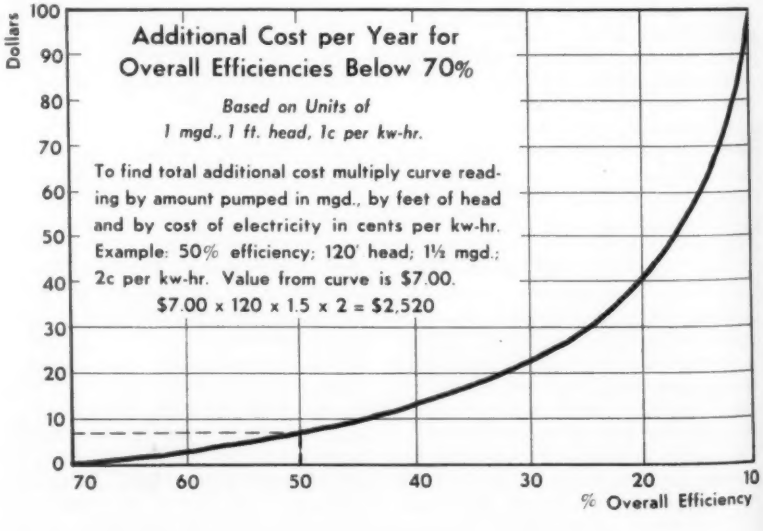


Municipal Power Plant Finances City Improvements

WM. H. GOTTLIEB

IN hundreds of communities, municipal power plants have assumed much broader functions than the basic task of supplying economical and dependable electric power. The economies of local power generation with Diesel engines, together with the profits of municipal distribution and sale of electricity, usually provide a substantial cash reserve. Most towns seek to return at least part of the profits to the consumer through reductions in lighting rates, many use power plant profits for civic improvement which otherwise could come only through borrowing and higher taxes.

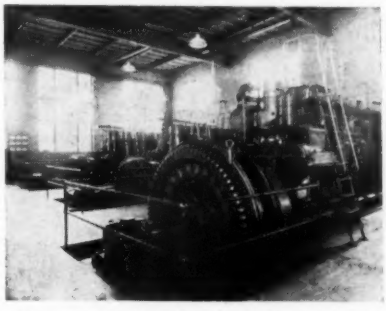
Paris, Kentucky, affords an excellent example of the important place a Diesel plant can play in community life. In 14 years of operation with Fairbanks-Morse Diesel engines, the municipal power system has produced a total net profit of $350,389.59. Of this sum, $212,634.79 has been contributed for municipal purposes and $137,754.80 remains in the surplus account.

The funds turned over to the city have been used to build factories to attract industry; to finance a new school; a hospital and a library; to build three concrete bridges; to buy a fire truck; to build a playground; to buy a street sweeper; and for other purposes.

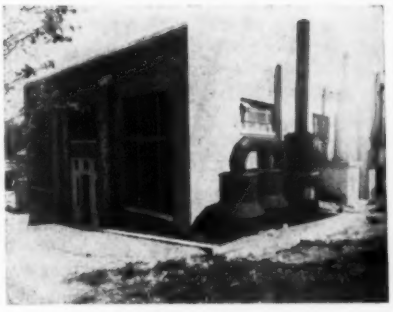
All these contributions, of course, are in addition to the plant's basic job, which is the provision of cheap, dependable power, a vital necessity to a city like Paris, and used by 31 industries, 268 retail stores and 1231 homes.

Not once in 14 years has there been an interruption of service due to engine failure. During this time, Paris' Diesels ran a total of 141,955 engine hours. The No. 3 engine, installed in 1934, had operated 59,041 hours by the end of 1947. In 1947, this unit was at work 7,329 hours out of a possible 8,760, more than 83.6 percent of the time.

In 14 years, the plant has produced 45,466,416 kilowatt hours at a total operating cost of $394,270.10, or 0.86¢ per kwh. This figure includes superintendence, labor, fuel oil, lubricating oil, maintenance, supplies, and miscellaneous expenses. Fuel consumption for the past few years has been well over 11 kwh per gallon.



Three F-M diesels which have given 14 years of service in the Paris plant.



Exterior view of Paris plant.

The first two engines, installed in October 1933, were Fairbanks-Morse 5-cylinder, 14 x 17-in. units, rated at 525 horsepower at 300 r.p.m. Each was direct-connected to a 357.6 kilowatt F-M alternator with 13 kw. direct-driven exciter. A few months later, a Model 33D16 F-M Diesel was installed, a 6-cylinder unit of 16-in. bore and 20-in. stroke delivering 1050 hp. at 300 r.p.m. This engine was connected directly to a 731 kw. F-M alternator. The 15-kw. exciter is driven by a 25-hp. motor.

These three Diesels carried the entire load for more than 13 years and all three are in full operation today. In 1947, a 7-cylinder Model 33F16 F-M Diesel rated at 1400 hp. at 300 r.p.m. with a direct-connected 980 kw. F-M alternator was installed. A fifth Diesel is on order.

To insure trouble-free operation, good protective accessories have been provided. Only soft rain water is introduced into the engine circuit of the closed cooling water system. Texaco Algol is used as the lubricant throughout the plant and Superintendent Edgar Dodge reports that they have never had a stuck ring. In 14 years, the connecting rod bearings have been taken up a maximum of .003 in. Lube for the three older engines is centrifuged with a Hydroil in continuous operation on scraper ring oil. The latest engine has a Honan-Crane lube purifier which operates when the engine does. All the Diesels have Madison-Kipp cyl-

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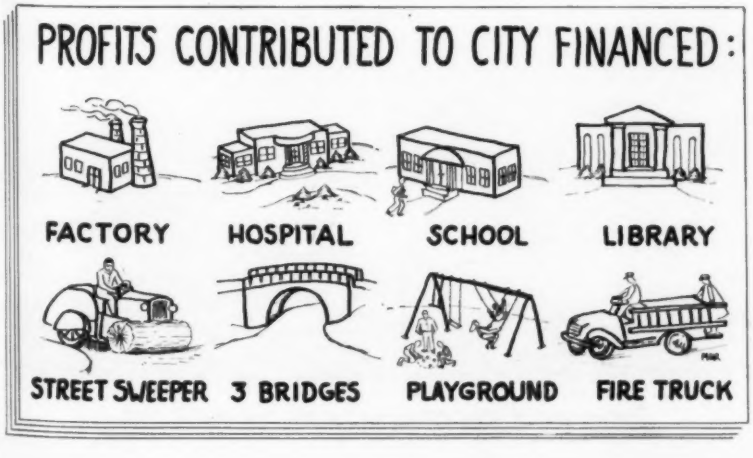


A purchase from war surplus fills many chlorination needs

Mobile Pumping-Chlorinating Unit

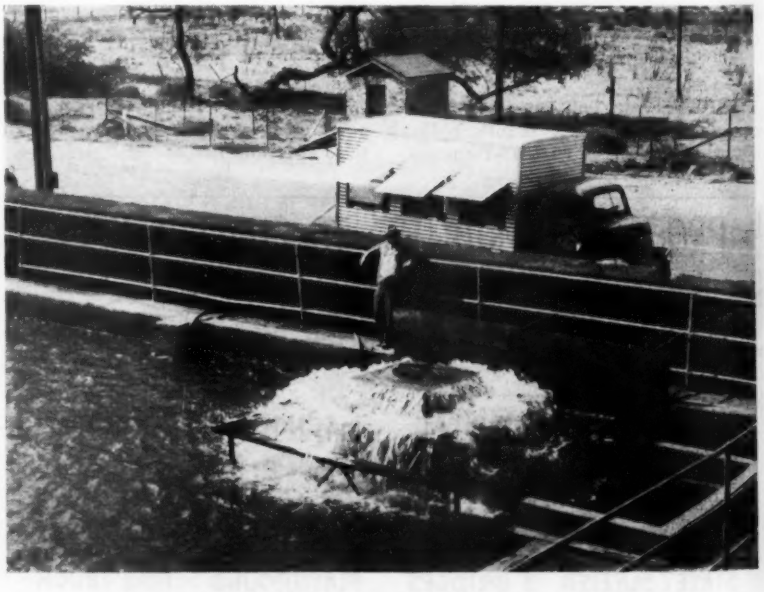
M. J. SHELTON
General Manager and Chief Engineer

L. L. FLOR
Sanitary Engineer, La Mesa, Lemon Grove and Spring Valley Irrigation District, La Mesa, California

OUR District purchased a war surplus Marine Corps mobile water purification unit in July, 1948. This was mounted on a four-wheel, twelve-foot trailer, and the total cost was $15. The unit was constructed by the Refinite Corporation of Omaha, Nebraska, and consisted of a Domestic self priming pump powered by a four cylinder Continental engine; two chemical pots for alum and soda ash; a rapid sand filter; and a Wallace and Tiernan chlorinator, type MDT with a total capacity, indicated on the manometer scale, of ten pounds of chlorine per twenty-four hours. The various equipment was connected with 1½" pipe; a five-way valve controls the filtration, backwashing and bypassing, etc. The maximum capacity of the plant is theoretically 100 gpm when bypassing the filter and 60 gpm when utilizing the filter.

The unit was far from impressive upon arrival but less than half a day's work by a mechanic resulted in its being cleaned up and placed in operation. Several tests were scheduled, under various conditions, to determine whether we could utilize the unit in our regular operations. The first test was the chlorination of a 10" main under a pressure at 75 psi; inasmuch as the chlorine gas is injected into the pump suction through a diffuser tube in this type chlorinator, the water pressure at the pump entrance had to be low or water would be forced into the chlorinator. Pump suction was taken from a fireplug and chlorinated water delivered into the main through a standard injector tube under a pressure of 100 pounds by use of the pump; chlorination was maintained to the degree necessary to obtain a residual of 0.75 ppm at a distance of 100 yards. The second test, taking water from a main at 100 psi and chlorinating a newly laid line at 0 psi was made successfully. The amount of chlorine used was raised by simply removing the liquid in the manometer and turning on more gas than would ordinarily be used with this type of chlorinator. A third test was made at the District's El Monte sump, to determine the actual amount of chlorine that could be utilized with the equipment. An accurate record of total time of operation, total amount of water pumped and treated, and weight differentials of the chlorine tank before and after completion of the test showed that more than 62 pounds of chlorine could be taken from the tank in 24 hours and a residual of 0.2 ppm was obtained nearly two miles distant.

The tests proved so successful that it was decided to use the unit regularly where treatment is required because of repairs to broken mains, new construction, etc. This called for "dressing up" and weatherproofing the unit, results of which can be seen in the accompanying illustrations. The District has obtained a number of surplus trucks and therefore had a cab-over-engine Chevrolet truck which had recently been taken out of continuous service. The entire unit, with 12′ bed and roof bows was mounted on the truck and the body covered with corrugated aluminum resulting in a van type body. Grills were installed over the openings which allows the unit to be placed in operation, locked and left running without an operator staying on duty. One man operates the unit, drives the truck to and from the site of treatment and is then able to carry on other duties while treatment is under way. It is in use almost daily, will serve our needs for years, and does a much better job of treatment than has been possible in the past.



Truck-mounted chlorination unit under test at 4.2 mgd.

Solving Savannah's Drainage Problem

D. D. HANKINS, JR.
City Engineer of Savannah, Georgia

ALL of the sanitary sewage and much of the storm drainage of Savannah, Ga., empties into the Savannah River. The drainage lines are laid to the approximate low water elevation and as the river at Savannah has a normal six-foot rise and fall with the tide, these lines discharge into the river only at the low-tide stage. High tide causes the water to back up in the lines. Savannah has grown south for a distance of some 3 miles and, on account of the low elevations, the sewer lines have about run out to the ground elevation. Any future expansion further south will necessitate the construction of pumping stations or in the case of sanitary sewerage, the building of disposal plants.

When I took office as City Engineer in January, 1947, the Horse and Buggy Day sewer system of Savannah represented my most serious problem. Savannah now has a population of 125,000 and like most cities the needs were greater than the income. The sewer system had been added to and patched for the last 50 years with no regard for an overall or master plan. To correct these bad conditions required money and a $2,500,000 bond issue was authorized, the money to be used for the expansion of our present water and sewer facilities and to enlarge some existing lines. Of the total, $900,000 was to be spent for sewers and $1,600,000 for completion of a water filtration plant and expansion.

Some of the Problems

As it would take several million dollars to correct our sewerage system, my problem was to spend my $900,000 allocation where it would do the most good and benefit the most people. We decided to employ a consulting engineer for several reasons. Our engineering forces were not adequate to make surveys and plans immediately for this work. Also several sections of drainage in Savannah needed correcting and I did not want to be placed in the position of stating where this money was to be spent. We employed Wiedeman and Singleton of Atlanta as our consultants. This firm has done much excellent work in this field and has an excellent background of experience.

The flooding of low areas shown in the illustration herewith was the worst condition that existed in Savannah and was given top priority for correction by both Wiedeman and Singleton and this office. Initially, $200,000 was prorated for this work but this amount was increased after further studies were made. During heavy rains which occur about twice a year, an area of approximately 50 blocks is inundated, sometimes for a period of two or three days, and to a depth of water (in the street) of about three feet. Water rises to the floor level of many of the houses. Under such conditions, boats had to be used to carry food and medical supplies to the occupants. A serious menace to the health of this community was presented.

Cause and Correction

The next step was to determine the cause of this situation and the most practical corrective measures. It was found that this area was in a basin and that the present drainage to the Savannah River to the north, a distance of about three miles, was through two 12-inch and 15-inch lines. These discharged into large box sewers that were already overloaded, so that the discharge was practically nil during flood conditions. The drainage to the south was carried to a County drainage canal; the City limits to the south was only 3½ blocks away. This County drainage canal discharged to a marsh river and at extreme high tides backed up to the City limits, preventing drainage from flowing away. The cost of building a large trunk sewer a distance of three miles to the river to the north was prohibitive; on account of the tidal action of the salt creeks, it would be impractical to carry the water to the south; there was no possibility of drainage to the west; so an outlet to the east was investigated.

It was found that a drainage canal at the extreme eastern city limits was low enough under flood conditions and large enough to take the additional required flow. Further studies were then made to determine the size of the pipe needed and the time of run-off, for the most adverse conditions, based on storms likely to occur once or twice during a ten-year period. Two alternates were presented for approval. One method planned on using a 72-inch concrete pipe with a run-off of only 5 minutes. The other plan contemplated on using a 60-inch concrete pipe with a run-off period of one hour. Since this would be ample for expected 5-year storms; and as the cost of the larger pipe was almost double that of the smaller pipe, the

Part of a 50-block area flooded during periods of heavy rain.

cheaper method was adopted on account of limited funds. To drain properly any location under all conditions would bankrupt any city.

Designing and Taking Bids

We were now ready to proceed with the plans which were prepared by Wiedeman and Singleton. The main trunk line was approximately 6,000 feet long, beginning with 24-inch concrete pipe and gradually increasing to 60-inch concrete pipe for the last 3,000 feet. Lateral lines were placed at every street intersection, extending several blocks in either direction, with catch basins and manholes. The estimate for this work was $350,000. Bids were taken on May 21, 1948; 180 calendar days were allocated for this construction with a $25 per day penalty set up in the contract in case of delay in completing the work on time. The following bids were received: Espy Paving and Construction Co., Savannah, $316,134.86; Diamond Construction Co., Savannah, $344,475.71; Blythe Brothers Co., Charlotte, N. C., $366,314.91; and Dixie Construction Co., Savannah, $381,815.80.

The bid of the Espy Paving and Construction Co. of Savannah, the low bid, was accepted and the contractor was authorized to proceed with this work. This project was started on June 15, 1948.

Doing the Work

The illustration herewith shows a section where the 60-inch pipe line is being placed. This cut is about twenty feet deep. The cut for this size pipe varied from 12 feet to 22 feet. Well points had to be used on all of these deep cuts. A section of the well point system is shown at the right of the picture. The one-yard crane in the background was used for the excavation of the trench and another crane of the same size was used for laying the pipe. The Scott Concrete Pipe Company of Savannah furnished all of the pipe for this project.

Each length of 60-inch pipe was four feet long and weighed approximately three tons. The engineer is seen in the left corner giving the line for the pipe. One inch tolerance for grade and line was allowed. This section of the street being only 50 feet wide, the question of where to place the spoil dirt presented a serious problem to the contractor. In many cases vacant lots were rented and the dirt was hauled to the lots and later hauled back to backfill over the pipe.

Many utility lines such as gas, water and power conduits which were not shown on the plans were encountered. This delayed the contractor somewhat and he requested a 30-day extension on the time limit of his contract. This was recommended by this office and this project was therefore completed well within the contract time limit and extension.

This project marks a forward step in the drainage of Savannah and is an important link in the master plan for future drainage.

One crane excavates 20' cut while another lays 60" pipe. Note well-point system at right.

Power Plant

(Continued from page 29)

inder lubricators. Each engine also is provided with a motor-driven Roper auxiliary lube pump to bring up pressure before starting and to maintain lubrication and cooling for a short time after the engine is shut down.

All intake air is filtered by American Air filters, impingement type for the first three, a Cycoil combination oil bath filter and silencer for the fourth. No. 3 also has an intake silencer. Exhaust gases vent through vertical Maxim silencers. Starting air is supplied by a pair of F-M compressors, one driven by motor, the other by a gasoline engine.

There are two alarm panels, one for the original plant and a separate panel for the No. 4 engine. Both include Alnor exhaust pyrometers and pressure gauges on scavenging air, lubricating oil and cooling water. Alarms sound if pressures go beyond prescribed limits. The No. 4 panel also has motor control buttons for the lube auxiliary pump, cooling water pump, evaporative cooler fan, and evaporative cooler pump. The 7-panel F-M switchboard is equipped with Weston voltmeters, ammeters, Kw. meters and synchroscope, Duncan totalizing kwh. meters, Bristol recording voltmeter, and Roller-Smith oil circuit breakers. There is an Allis-Chalmers rocking contact voltage regulator of the Brown Boveri design for each engine.

The plant is staffed with four operators working six 8-hour shifts every eight days. Pistons are pulled for inspection once a year with the regular staff handling most of the maintenance jobs. Aside from Superintendent Dodge, responsibility for plant operation is vested in City Managing Agent Boone Baldwin. A six-man utilities board supervises the power and water systems with ultimate authority resting in the hands of Mayor George Doyle and the four city commissioners.

Street and Sewer Costs

According to O. B. Erickson, mayor of St. Louis Park, Minn., costs of street and sewer work have increased from 1940 to 1948, as follows: Sidewalk, from $1.25 to $2.16 per sq. ft.; curb and gutter, from 65¢ to $1.35 per lineal foot; and sanitary sewer from $2.92 to $5.85 per lineal foot. These data are from *Minnesota Municipalities.*

HD-10 tractor clearing right-of-way.

Grading completed, ready for surface.

Widening Farm-to-Market Roads By Force-Account

ADAM M. NOLL

Resident Maintenance Engineer, State Roads Commission, Calvert County, Md.

MARYLAND'S smallest county, Calvert, is a leg-shaped peninsula jutting into Chesapeake Bay and the Patuxent River in the southern section of the State. It is solely an agricultural county, rimmed by fast growing developments on its waterfront, mostly of the "summer colony" type.

In 1933 the county road system, 120 miles of dirt and gravel, was turned over to the State Roads Commission for maintenance. Proceeds of the county's share of the lateral roads gasoline tax was applied to this work. All other direct taxes previously levied by the county for the road system were dispensed with, and the roads were maintained from its share of the gasoline tax alone.

The State undertook this work by setting up maintenance crews who worked independently of the forces maintaining State highways, with pay differentials favoring State system workers, but under the same general supervision, from the same shops with State-owned equipment.

Cooperative Work

With the work on the State system and the County system so closely related physically, it soon became apparent that for greater efficiency the two should be joined as closely together as possible, under equal wage scales and equal benefits, but with each employee maintaining his status with the State or County.

At the present time the system has grown to 180 miles and for routine maintenance work this is divided equally between two foremen, each having a truck and four laborers. Equipment such as patrol graders, pull graders, tractors, power shovels, etc., are "pooled" for assignment on either State or County roads as needed. This system keeps the "pooled" equipment always busy and holds down unproductive overhead.

For "out-of-routine" work on County roads, such as bridge replacements, widening, or emergency jobs, special crews are made up from the different State or County crews to meet the situation. This special work may be handled by either a State or County foreman, depending on which can best be spared from his maintenance section.

With advent of the consolidated schools, school buses and other developments increased farm-to-market road needs. It was obvious that something had to be done to widen and surface the existing narrow, and for the most part, dirt roads to meet the situation. The amount of Federal funds allocated to the County for construction was, and is, very small even when, as stipulated, it was matched by a like sum of County funds. The County Commissioners realizing the very limited improvements they would get by watching these funds and having it spent under State and Federal specifications requested the State to relieve them of participation. They felt that they could take this matching fund, which would have to come from their road maintenance budget, and accomplish more by having the State spend it on "improving" the County system under local specifications.

Therefore, the State Roads Com-

Bituminous surfacing and creosoted bridge on a completed section of road.

mission with approval and recommendations of the County Commissioners, undertook to widen some school bus, mail route and waterfront access roads with funds from the maintenance budget. This, of course, lowered the dollar per mile for over-all maintenance mileage, but even at the expense of this reduction it was immediately evident that something constructive was being done.

In this widening work, not too much concern is given to straight lines and easy grades, as the primary objective is to provide a safer, year-round road.

After the required 30-ft. rights-of-way are donated to the County, a foreman, a driver and truck, a No. 12 Caterpillar patrol grader, an Allis Chalmers HD-10 tractor with dozer, and two or three laborers are assigned to the project. Each property owner is contacted about the "line" as it affects him. This is staked out for a 24-ft. graded width, laying hard into curves and bends to provide the best permissible sight line. After fences have been removed by our forces (we are now endeavoring to require the property owners to remove them as a direct cost of obtaining a better road) the dozer moves in, clearing the right-of-way of all trees and debris and pushing it all into the nearest gully or out-of-the-way place with permission of the property owner. The dozer carries out the rough grading, moving dirt in short, two-way pushes where possible and necessary. The dozer is followed by the No. 12 for sloping cuts and finishing off the grade. Where cuts are too deep for sloping, the dozer drops back to help out. After the finished subgrade is put on by the No. 12, the dozer makes cross-cuts for drainage lines and clears openings for the patrol grader to cut inlet and outlet ditches.

Upon completion of the drainage lines, a "floating" crew with four or five trucks and a power shovel move into the nearest gravel pit and place from 4" to 6" of gravel surfacing 16 ft. wide on the subgrade. The gravel is spread and shaped by the No. 12. Upon completion it is turned back to the "section" foreman for routine maintenance.

The entire time for the completion of an average mile of road is about three weeks. The average cost per mile is approximately $3,000. However, since Maryland has a $3,000 limit of expenditures without contract, we are obliged to limit expenditures on any one project within that amount, even though the work involved is nothing more than delayed maintenance.

After one year, sometimes within the year if compaction has been reached, these widened roads are bituminous surface-treated. Upon completion of this final stage of the program, the rural public feels that, at long last, something really constructive has been accomplished.

With 22% of the County system widened and stabilized with bituminous material within a few years, and with no additional costs on the right hand side of the tax bill, the demand for this type of road is growing by leaps and bounds. However, the problem of higher maintenance costs have greatly reduced the amount available for these improvements and the program must necessarily slow to a stop unless additional funds are provided.

Nevertheless, with the Calvert County public becoming increasingly interested in this type of road for their rural communities as a tie-in to their State system, it is felt that some means will be found for it to continue.

Earning Your Salary

(Continued from page 28)

termined by finding the efficiency of the pumps.

Efficiency of Pumps

One phase of operation that is often neglected is deep-well pumping. Because of the nature of the installation it may be the tendency to neglect a centrifugal pump as long as it delivers the volume of water required of it. Since the pump is set deep in the well, it is difficult and expensive to remove the unit for inspection and needed repairs. A pump will not operate efficiently for an indefinite period of time without some form of maintenance.

A few minutes' time spent in calculating the cost of pumping will show the plant manager how expensive an inefficient pump may be. He can then show where the expenditure of money on needed repairs, or the purchase of a new pump, will produce a high return on the amount spent. If the pump is replaced it need not be discarded altogether, but may be used as an emergency on stand-by unit.

At first thought it might seem that the relation between the loss of efficiency and the extra power required to pump a given volume of water would be a straight line. However, this is not the case. The extra power required increases at a faster rate than the loss of efficiency. The chart showing the amount of money lost per year through the use of inefficient pumps, illustrates this fact clearly. In constructing the curve it was assumed that the overall efficiency of a new pump and motor would be 70 per cent. The loss, as represented by the curve, is based on the loss of efficiency below 70 per cent. The units are one mgd. pumped against 1 ft. of head with the cost of electrical power at 1¢ per kw-hr. The actual loss may be obtained by multiplying the figure obtained from the curve by the proper factors. For example, if the overall efficiency drops to 40 per cent, the loss for 1 mgd pumped against 100 ft. of head would be about $1,230 per year. If 10 mgd were pumped against 200 ft. of head at an overall efficiency of 40 per cent and with electrical power at 1.5¢ per kw-hr the yearly loss would amount to $36,900.

Of course, for the operator to determine the efficiency of any particular pump and motor, the pump and motor will need to be connected to meters to record the kwh consumed and the amount of water pumped against a certain head. With the proper data the overall efficiency may be found by the formula:

$$e = \frac{gh}{318{,}505k}$$

where e = efficiency
g = total number of gallons of water pumped
h = height water is pumped plus friction loss in ft.
k = kw-hr consumed in pumping g gallons of water against h ft. of head.

The horizontal centrifugal pump is usually not subject to the abuse of the deep-well pump. However, regular checks also should be made on the efficiency of this type of pump.

It is up to the plant manager or superintendent to determine where and how a saving in operational costs may be made. If he has accurate and up-to-date cost data he can determine where and in what respects his expenses are more than they should be. A thorough study of methods and procedures then may reveal improvements which will result in substantial savings.

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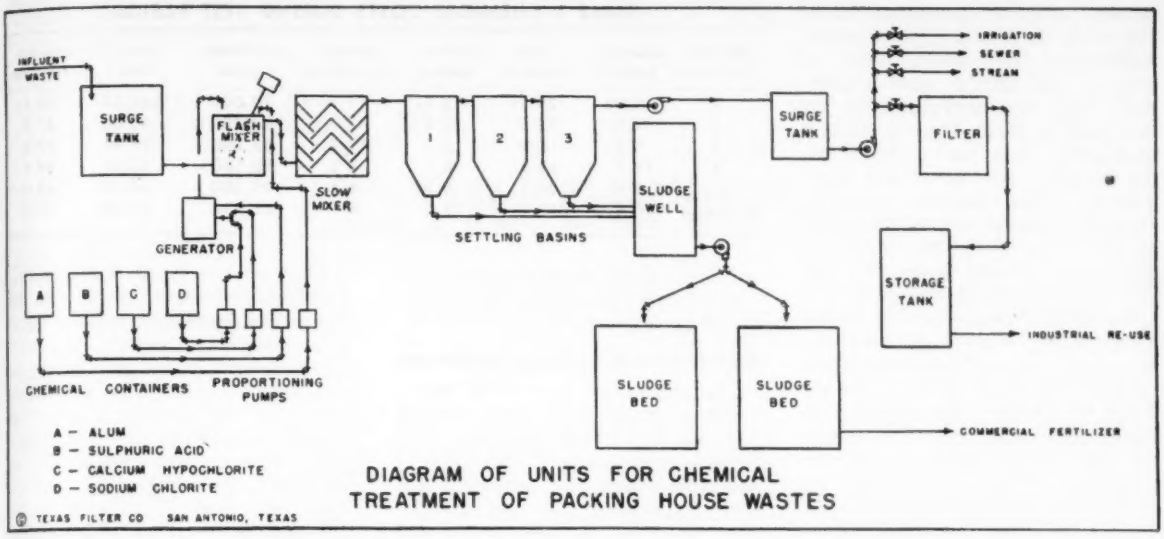

DIAGRAM OF UNITS FOR CHEMICAL TREATMENT OF PACKING HOUSE WASTES

Chemical Treatment of Packing House Wastes

JACK HUPPERT

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CHEMICAL treatment was used successfully by a North Texas packer to solve his waste disposal problem. This plant is comparatively small with something under 100,000 gallons of waste per week; however, it is located in a region where both high temperatures and long periods of dry weather prevail. These put the effectiveness of the treatment process to a very rigid test. The best indication of the success of the plant described here is that during the period of test operation, from April 17, 1948 through May 22 1948, and to the present (Jan. 1949), there has been no complaints from odor nuisance or stream pollution.

In this type of treatment, it is not necessary to treat all wastes alike. However, in this case, as is likely to be the case in other small plants that do not wish to salvage the various waste materials, the blood, fat particles and other waste materials were not separated, but were run into a surge tank together, and from there into a flash mixer where enough sulphuric acid was added to drop the pH to the range 5.4 to 5.7 This coagulated all of the blood and much other material. Next, enough aluminum sulphate was added further to drop the pH to 5.5 or below and add to the floc. Enough chlorine dioxide was also added to give a slight chlorine residual. This excess of chlorine dioxide tended to oxidize the organic matter, and it also kept down odors in the settling basins, the effluent water and the sludge. In addition, the low pH tended to pickle the waste to a point where biological action on putrescible materials remained inactive for an indefinite period. (Actually, some of this treated material was permitted to stand as long as 30 days in open jars in the sun with no noticeable disagreeable odors and no hydrogen sulphide). Following precipitation of practically all of the solid matter in the last of the settling basins, chlorine dioxide was again added through a horizontal spray. This post-treatment produced a chlorine residual in the effluent.

The effluent was used for irrigation, discharged to a stream, or reused in the barometric condenser which operated with the rendering kettle. The color of the water ranged from a straw to clear. It was never without some BOD, though this was reduced from 50% to 75%; maximum BOD reduction during the test period was 90%. A trickling filter, following the above described treatment, although not employed in this installation, would provide a clear effluent and further reduce BOD.

Description of Plant

Flash Mixing.—The flash mixer was made of a 30" tile with the bottom concreted and the tile coated with asphalt base paint. Agitation was with a 1725 rpm, small blade-impeller, which gave a very complete mixing of the chemicals and trade wastes, and also helped to disintegrate the larger particles. The chemicals were added accurately by proportioning pumps. The pH was watched closely; also the time of settling in an Imhoff cone. As shown in the plan, raw materials enter near the bottom of the mixer, flow upward, and go out near the top. This, we found, gave a properly balanced mixture of chemicals and waste.

Flocculation. — Flocculation was accomplished by an unusual design which serves as a deep sludge bed while giving a slow, smooth and even upward movement to the floc. The baffles run completely across the inside of the tank and are placed in an inverted "V" position through the center at approximately a 45° angle. There is a 4" spacing between the baffles. On the opposite side walls, baffles are placed in the same position.

About once weekly it is necessary to drain the flocculating chamber into the sludge well because heavy materials such as pieces of hoof and bone accumulate at the bottom of the tank.

Settling. — The settling unit is composed of three individual basins, square at the top and conical at the

bottom, so as to concentrate all of the solids to a central point. After flocculation, the waste flows by gravity, through a short conduit with very little turbulence, to the first settling basin. Here it meets a baffle plate that evenly distributes the incoming flow across the basin. The flocculated material begins to settle out within approximately 6″ to 12″ after it enters the first basin. The finely divided material passes into the second basin through a separation baffle between the two basins. This opening in the separation wall is approximately 6″ below the liquid surface, and is 6″ wide across the width of the tank. By the time the liquid leaves the second and enters the third basin, it has practically no suspended solids. As soon as the liquid enters the third basin, chlorine dioxide is again added for final sterilization. A baffle evenly distributes the flow of the water across the surface of the third basin. The treated waste then flows to a surge tank, from which a float operated pump delivers the effluent as desired: (1) to a filtering plant; (2) to a water storage tank; or (3) for irrigation. If the water is not to be used for any of these purposes it may, of course, be diverted to a stream or sewer.

Sludge Well.—The sludge well is a concrete pit, the bottom of which is approximately 4 ft. below the bottom of the settling basin. Since the well is built up as high as the top of the settling basins, it is possible to drain all of the sludge from the three basins into the well at one time. The sludge is picked up with a non-clog type pump and pumped to a sludge bed.

Sludge Beds.—Two sludge beds are used. One, 20′ by 20′ square, has a 4′ embankment around it, and a bottom of 30″ of mixed gravel, with a 6″ sand layer on top. The other bed is 40′ by 40′ square, of the same construction. Sludge from the sludge well is placed on one of these beds daily for approximately two weeks. It is then diverted to the other bed, permitting the first bed to dry. The sludge, when dry, makes a desirable fertilizer and can be sacked or sold in bulk.

Filtration of Effluent.—With efficient coagulation and precipitaiton of the waste matters in the settling basins, the effluent water will vary little in color and turbidity. With the use of diatomaceous earth or sand type filters, the excess turbid matter may be filtered out and the water can then be reused for washing floors, operation of barometric condensers, or other purposes. The use of trickling filters would greatly reduce BOD and lower the initial chemical requirements.

TABLE I—CHEMICAL COSTS DURING TEST PERIOD

Weekly Test Period	Aluminum Sulphate	Acid Sulphuric	Chlorite Sodium	Calcium Hypochlorite	Gals. Waste Treated	Total Cost	Cost Per 1000 Gals.
1	9.9c	29.1c	13.1c	11.7c	72,000	$45.94	63.8c
2	14.3	14.8	11.1	7.1	84,480	40.00	47.3
3	9.5	6.0	10.2	11.7	85,140	31.89	37.4
4	11.7	21.2	8.2	8.3	92,160	45.51	49.4
5	8.4	20.1	7.9	6.6	95,000	40.84	43.0
Average	10.8	18.2	11.0	9.1	85,756	40.84	47.8

Cost Factors in Chemical Treatment

Accurate cost data were maintained from April 17, 1948, through May 22, 1948. Since that time, costs have been cut considerably, due to increased efficiency of operation and more experience with the process. Cost data for the test period are given in Table I.

Admittedly, these costs of operation would not be economical in a large plant. On the other hand, such costs are not prohibitive; and it is certainly better to pay them than to shut down. The plant under consideration was permitted to operate and treatment was considered practical and as near sanitary and odorless as could be expected for a plant of this type.

It has been demonstrated in the period of operation since these tests were made that the costs shown in Table I are somewhat higher than normal. This higher cost resulted both because of the newness of the operation and because some experimentation was done with higher priced chemicals. It has since been found possible to replace the chlorine dioxide solution with a solution of chloric and hypochlorous acid with entirely satisfactory results and at a significantly lower cost. The operating costs during October, 1948, amounted to 25.82c per thousand gallons treated; it is likely that this figure is somewhere near the minimum.

Against the seemingly high chemical cost shown, several factors should be balanced. The most important of these is a very low initial cost. Because of the greatly accelerated rate of treatment a small installation is practical. Some indication of the size of plant needed in this case is given by the fact that the total elapsed time for the flow of the waste material through the plant is only about 1½ hours. Labor costs are kept to a minimum because the plant is semi-automatic and requires only occasional observation and chemical make-up. The plant under test utilized unskilled labor.

Some salvage values are possible. These will, of course, vary with the plant and the conditions under which it operates. Water used for irrigation has a definite value and might be sold. Dried material from the sludge beds also has definite commercial value as agricultural fertilizer. Water that is filtered, stored and reused in the plant also results in a saving. While the total of these is small, they should be given some consideration in computing the total cost of the chemical process.

Size of Chemical Plant.—A building approximately 25′ by 25′ will house all of the necessary chemicals, their containers, and the pumps and filters necessary to operate a plant having a capacity of 30 gpm. The chemical containers are generally 55-gallon rubber lined drums. The pumps and filters within this building are placed in line near the walls, and the proportioning type pumps are placed on shelves attached to the walls. This gives maximum efficiency in utilization of space and consequent lower cost of building construction.

Measuring Road Roughness

A road roughness indicator, constructed by the Virginia Highway Department, after the design of the Public Roads Administration, has been used to evaluate Virginia highways. An electric counter measures the roughness in inches per mile at a speed of 20 mph. Roughness measurements ranged from 272 to 62, with an average of 156 for all projects tested. Average for various types were: Bituminous concrete, 84; portland cement concrete, 112; waterbound macadam, 193; and penetration macadam, 200. This indicator was found to be a quick and dependable method of measuring riding quality and many check tests proved that reproducible results can be obtained. Detailed results were contained in a paper before the Highway Research Board by R. L. Sheppe, associate research engineer, Virginia Department of Highways.

Planning for CIVIL DEFENSE

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THE establishment of a continuing office of civil defense, with a national headquarters, is recommended in a 300-page report "Civil Defense for National Security" recently made public. The report proposes an organization which is intended to function in peace as well as in war. In addition to the national headquarters, which would have a small full-time staff, the report recommends: (1) that basic operational responsibility be placed on states and communities, with mutual assistance plans and mobile supporting facilities to meet emergencies; (2) that maximum utilization be made of volunteers and of existing agencies, as well as of available skills and experiences; (3) that trained supporting and reserve units be organized in major communities, which units will be trained and equipped for all probable emergencies; (4) that specific plans, based on continuing research, be made to meet hazards of atomic bombs or other types of warfare; and (5) that a peace-time organization be developed that will be of value in natural disasters, even though it may never have to be used in war.

These plans are based on our own and our allies' experiences in World War II, including the studies of the effects of bombing in Germany, Japan and England. National, Regional and State organizations are recommended. The primary function of the national organization is to provide overall leadership, set patterns for procedures and establish principles of operations. The regional offices coincide with Army areas and appear to be primarily for coordinating purposes. The state organization coordinates and supervises the work within the state. The local organization does the work.

The State Organization

The governor of the state is, naturally, responsible for the welfare of the state and, as such, for civil defense. His director of civil defense should hold cabinet rank. There should be an advisory council of citizens and representatives of the state government. Provision is made for five deputy state directors of civil defense. These are: (1) Engineering, communications, transportation and air raid warnings; (2) plant protection; warden, police and fire services; and mutual aid and mobile reserves; (3) health and medical services; and radiological, chemical and special weapons defense; (4) evacuation and civilian war aid; and (5) administration, planning, training and public information.

The deputy director for engineering will normally be the state engineer or state director of public works. The deputy director for health and medical services may be the state health officer. No special qualifications are stated for the other directors.

The Local Organization

The local or working organization is almost a duplicate of that recommended for the state. The mayor or city manager is the responsible head and he should have, in addition to an advisory council, a director of civil defense and five deputy directors. These have essentially the same duties as have already been enumerated for the state organization. The deputy director for engineering, transportation, air raid warnings, rescue and communications will probably be the city engineer or director of public works.

Civil defense requirements and operations involve techniques in many fields of engineering. Plans must be made to insure safe and adequate water supply and sewage disposal; and to provide housing and milk and food supplies. Protection may be necessary against insect and rodent-borne diseases. Broken water, sewage and gas mains, and telephone and power lines may need to be repaired. Bridges and roads may need major engineering attention. Rescue services, demolition and debris removal may be necessary. In addition to all this will be the need for sound engineering advice in construction of shelters and control centers; for protection of utilities, essential industries and public buildings; and for camouflage and blackout measures.

In the civil defense program, all engineering has been taken away from medical control and has been placed under engineering direction.

Water Supply Problems

Since safe water is needed for domestic use and large quantities might be needed for fire fighting, maintenance of the supply system is an absolute necessity. The Engineering division must be organized for the protection of the water supply, including (1) determination of vital points in the waterworks system and means for protecting them; (2) preparation of policies for control or restriction of watershed use; (3) initiation of special analyses required to determine the presence of unusual types of pollution; (4) organization, equipping and training of competent crews able to make extensive repairs to damaged plants or lines; and (5) preparations to enable utilization of alternate supplies in case the principal supply is damaged. In addition preliminary studies and plans should be made to provide for installation of valves to reduce water losses in case of distribution system damage; for completely mapping the waterworks system, with copies of

The Basic Principles of Civil Defense:

The individual, given such training as can be provided, does everything possible for his family and himself;

The community, organized and equipped, puts its civil defense resources at work;

If these are inadequate, mutual aid and mobile reserves from other communities are brought in;

If all of these are unable to meet the needs, the army aids; and, if necessary, martial rule goes into operation.

the map maintained at various locations; for surveying chlorination supplies and facilities and planning accordingly; for studying the needs for repair parts stocks and establishing adequate supply factors; for studying private and institutional water supplies in the locality, including swimming pools, which might be helpful in an emergency as a means of purification or for supplementary supply; and for making a census of tank trucks which might possibly be used for transporting water.

When these are to be done and where the funds will come from are not mentioned.

The function of the Medical division in regard to water supply is primarily that of inspection for safety, including making tests for water purity and recommending and supervising field treatment of emergency supplies if this is necessary.

Sewerage and Refuse

In sewage collection and disposal, the Engineering division must plan and organize, so far as possible for prompt repairs to sewers; for the provision of portable engine driven pumps for handling flows from broken sewers; for protecting the sewage treatment plant against damage or sabotage; for the use of chlorine for emergency sewage disinfection; for portable comfort stations; for a scavenger service, with regular collection and safe disposal of wastes; and for temporary latrines or other suitable methods where necessary. Plans for garbage collection and adequate disposal should be made.

In sewage disposal, the Medical division conducts inspections to determine the sanitary safety of waste disposal installations, and develops recommendations for excrete disposal if this becomes necessary. It also maintains sanitary inspections in regard to garbage, dead animals and other wastes of the general nature; but the performance of the services of waste collection and disposal are entirely functions of the Engineering division.

Milk and Food; Insects and Rodents; Housing

The responsibility for the control of milk and food is not clearly defined. In general the Medical division is responsible for pertinent inspections, and for policies for emergency milk treatment. Housing is almost wholly an engineering responsibility. It includes provision for temporary housing and for mass feeding, with protection from the elements; insurance of proper air space in shelters for each occupant; ventilation and screening and water supply and waste disposal for such temporary housing. The problems of cleanliness of premises and bedding, sterilization of cooking and eating utensils and examination of food handlers are mentioned but not specifically assigned, though they would probably be functions of the medical division.

It is the responsibility of the Medical division to establish the necessity for insect and rodent control for health protection in disaster areas. The application of control measures would probably be by the Engineering division, with necessary assistance from the state and from the armed services, when special equipment or facilities are required, as airplanes for spraying.

Protective Construction and Concealment

The design and construction of protective devices, for public buildings and essential industrial plants, depends upon factors relating to weapon development which cannot be evaluated with any accuracy at the present time. The same is true of the design of shelters. The information on these subjects in the Civil Defense plan is restrained. In a generally similar manner, data on protective concealment and camouflage are general only. These are subjects which, for the fullest measure of success, require in addition to technical data, special abilities and backgrounds. The local Engineering division would be responsible, for normal work of this kind but would require skilled guidance from higher echelons for initial planning.

Medical Services

The Medical division duties enumerated previously in connection with the outline of engineering services covers many of the responsibilities of the Public Health Branch. But that branch is also charged with epidemiological studies in connection with communicable disease; with quarantine and isolation measures; with inoculation and vaccinations; and with control of TB and VD. To it is also delegated the responsibility for an industrial medical and hygiene program; for maternal and child health; for mental hygiene; for veterinary medicine; for nutrition; for public health nursing; for vital statistics and mortuary services; and for laboratory facilities.

The Medical Care Services Branch has the job of caring for the sick and injured, including emergency treatment of casualties and the establishment of medical services for the public, whether at home or after evacuation. In addition, this branch will provide and supervise nursing, dental and pharmacy services. Medical supplies will be the responsibility of the Army Medical Department's Medical Supply Division.

The responsibility for radiological, chemical and other special weapons defense also rests with the medical division. However, the Chiefs of these divisions will probably not be doctors, but men with special background and training in these respective fields of work.

Metropolitan Areas

The problem of Metropolitan areas are recognized in the report and it is recommended that the combined resources and facilities of all municipalities involved should be pooled and civil defense operations for the area should be carried out as in one municipality. Where state lines are involved as around New York City, the communities in each state may form their own organizations, and then develop effective cooperation arrangements covering all areas.

Mutual Aid and Mobile Reserves

Since the resources in protective services in any community will be limited, the establishment of mutual aid and mobile reserves is considered essential. Both federal and state reserves are recommended. Mutual aid was well developed during World War II, and agreements of this nature exist in many communities now. These should be extended and clarified so that there is complete understanding and necessary authority.

Tables of organization have been worked out for Mobile Reserve battalions. The Class "A" Civil Defense Mobile Reserve battalions are established under state control and equipped in part by the federal government. Class "B" battalions are under state or local sponsorship.

It is proposed that 100 Class "A" battalions be organized and federally reorganized. Of these 85 would be assigned to states and territories. Each of these would consist of 513 men, divided into 8 sections: fire fighting (53 men); installations repair (73 men); food (43 men); medical (68 men); radiological (37 men); rescue and clearance (83 men); police (58 men); and chemical decontamination (43 men). A civil air patrol flight of 6 planes and 12 pilots would be attached.

Mobile Reserve battalions, Class "B," an essential part of the third line of Civil defense are established under state or local sponsorship and

are normally for service within the state. Such state may organize as many as it deems necessary.

Basic policies for mobile reserve battalions include the following: Federal supply for Class "A" units, but not for Class "B." Responsibility for pay, losses of equipment, death and disability for members, either by the federal government or by the state. Authority for employment of these battalions rests with the governor. Insignia, shoulder or arm patches or uniforms will be worn on active or training duty. State headquarters will be provided for mobile reserves, and training is contemplated for a "maximum number of key personnel."

Training

Since the plan for Civil Defense embraces a wide range of activities, some of which have no peace-time counterpart, the necessity for training is especially apparent. The training and personnel utilization program involves (1) the selection and assignment of personnel; (2) their education and training; and (3) the training and general education of the public. For effective personnel utilization, functional analyses will have to be made of the various civil defense activities and services and detailed job analyses of the positions to be filled. Then it will be necessary to select and fit personnel, principally volunteers, for these jobs. After selection, it is believed that all personnel will need both general and specific training and guidance, since they must often learn new techniques and adjust and reorient previously developed skills. Also, they must be taught to cooperate and work with others. Overall training programs will be prepared by the national office but the actual conduct of instruction, must, of course, be a responsibility of the local organization.

Manpower

Only estimates can be made of the number of persons that will be needed for Civil defense, but in a grave emergency the total might well run to 15 million or more. Probably 500,000 will be needed for positions of technical and administrative leadership under such conditions. In peace-time there will be a small group of full-time employees in the federal organization, and each state would also need a small staff wholly engaged in this work. In emergencies, both will need to be augmented. The problems of manpower are very great, since there will be an overlap with the needs of the armed forces. However, Civil defense must in the main, procure its manpower requirements from personnel not liable or eligible for military service.

Conclusions

It is believed that there are two major problems to be conquered if this or any other plan for Civil defense works. The first is Selective Service, which is not and never will be qualified to determine where professional men are essential for the best interests of the nation. We are suffering now from the misuse of professional and scientific skills by Selective Service during the past war. Some arrangements must be made whereby certain key personnel will be protected.

The second problem of a major nature is the job analysis and selection of personnel to fill the many thousands of jobs requiring professional or technician skills. When we remember that the Corps of Engineers has not been able to classify the skills of some 40 or 50 thousand reserve officers who served with it during the war, the problem of filling adequately the estimated 500,000 "positions of administrative and technical leadership" is a very large one.

Lighting for Snow and Ice Control Equipment

Recommendations for a uniform method of lighting snow removal and ice treating equipment were presented at the meeting of the Highway Research Board by J. E. Lawrence, Maintenance Engineer of the Massachusetts Highway Department, who headed a committee studying this subject. It was recommended: (1) That blue identification lights should be located on the cab, which should be of the flashing type, visible in all directions, and have a minimum light intensity of 21 to 32 cp with a lens not smaller than 6-inch.

(2) A clearance light should be mounted on the left of the cab and this should be adjustable to the extreme width of the plowing equipment. A clearance light should also be placed on the right side of the cab when plowing wings are not used; when they are used, flood lights should be provided to illuminate the plowing wing or wings. The color of the clearance light should be amber from the front and red from the rear. The clearance lights should be not less than 2-inch, with ordinary tail light intensity.

(3) Other lighting should be provided as follows: Truck headlights to be raised to clear operating equipment, using auxiliary headlights if necessary; and additional operating lights may be located on top of the cab or elsewhere to illuminate the plowing or spreading equipment.

Public Works Improvements in Worthington

During 1948, according to the *Daily Globe* of Worthington, Minn., that city completed contracts for water and sewer extensions totalling $152,000; carried out a paving program amounting to $420,000; constructed a new well costing $25,000; and was prevented from completing a $70,000 elevated water tank only by bad weather. C. D. McMurtry is city engineer.

Cat D7 with Traxcavator and Hyster equipment handling large pipe and fittings on pipe laying job.

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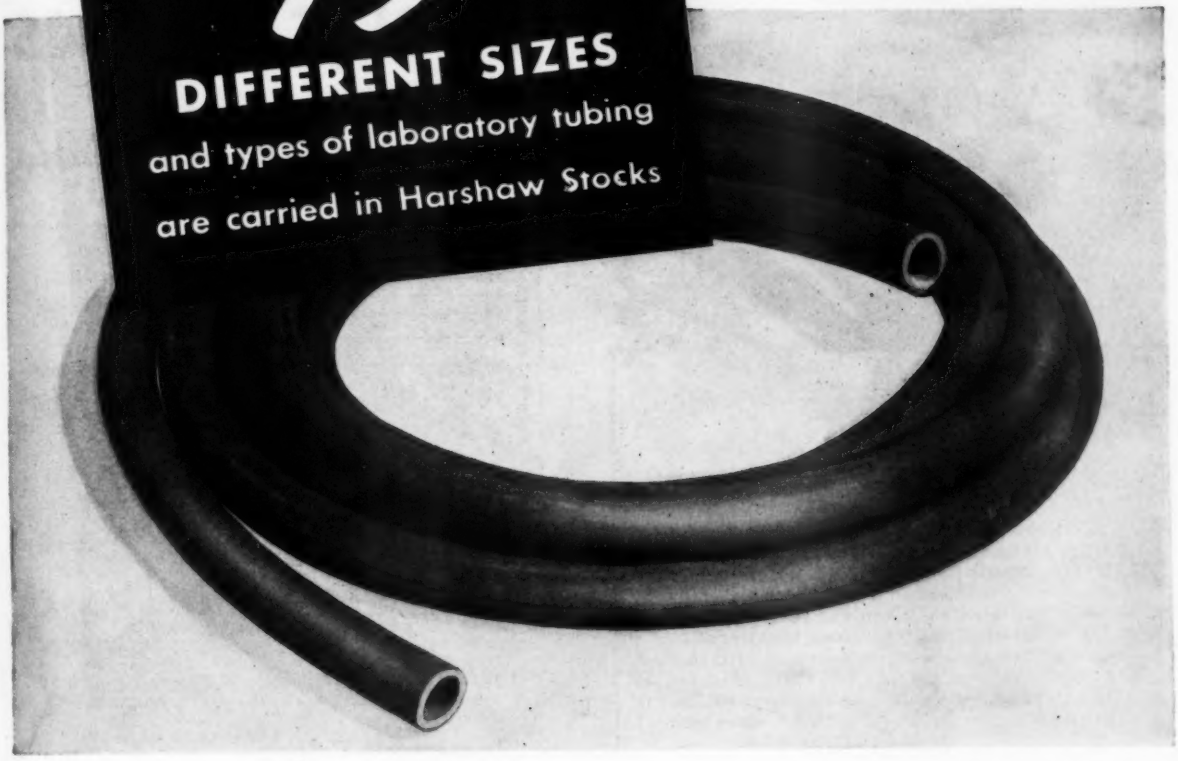

H-57800 Tygon Flexible Plastic Tubing. Formulation S 22-1

Bore, in.	1/8	3/16	1/4	5/16	3/8	1/2	3/4	7/8	1
Wall, in.	1/16	1/16	1/16	1/16	1/16	1/16	1/8	3/32	3/32

H-57810 Tygon Tubing in a new convenient dispensing container. Packed 50' to a reel. This package keeps Tygon Tubing clean and prevents waste.

Bore, in.	1/8	3/16	1/4
Wall, in.	1/16	1/16	1/16

H-57900 Neoprene Tubing, Medium wall.

Bore, in.	3/16	1/16	5/16	3/8	1/2
Wall, in.	3/64	1/16	1/16	3/32	3/32

H-57910 Neoprene Tubing, Heavy wall.

Bore, in.	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
Wall, in.	1/16	3/32	3/32	3/32	1/8	1/8	1/8	1/8	1/8

H-57930 Amber Rubber Tubing, Medium wall.

Bore, in.	1/8	3/16	1/4	5/16	3/8	1/2
Wall, in.	3/64	1/16	1/16	1/16	3/32	3/32

H-57940 Amber Rubber Tubing, Heavy wall.

Bore, in.	1/8	3/16	1/4	5/16	3/8	1/2
Wall, in.	1/16	3/32	3/32	3/32	1/8	1/8

H-57960 Black Rubber Tubing, Medium wall.

Bore, in.	3/16	1/4	5/16	3/8	1/2
Wall, in.	3/64	1/16	1/16	3/32	3/32

H-57970 Black Rubber Tubing, Heavy wall.

Bore, in.	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
Wall, in.	1/16	3/32	3/32	3/32	1/8	1/8	1/8	1/8	1/8

H-58000 Red Rubber Tubing, Medium wall.

Bore, in.	1/8	3/16	1/4	5/16	3/8	1/2
Wall, in.	3/64	1/16	1/16	3/32	3/32	

H-58010 Red Rubber Tubing, Heavy wall.

Bore, in.	3/16	1/4	5/16	3/8	1/2	
Wall, in.	3/32	3/32	3/32	1/8	1/8	

H-58020 White Rubber Tubing, Medium wall.

Bore, in.	3/16	1/4	5/16	3/8	1/2	
Wall, in.	3/64	1/16	1/16	1/16	3/32	

H-58030 White Rubber Tubing, Heavy wall.

Bore, in.	1/8	3/16	1/4	5/16	3/8	1/2
Wall, in.	3/32	3/32	1/8	1/8	1/8	1/8

H-58050 Pressure Rubber Tubing, Black.

Bore, in.	1/8	3/16	1/4	5/16	3/8	1/2
Wall, in.	1/8	3/16	3/16	3/16	1/4	1/4

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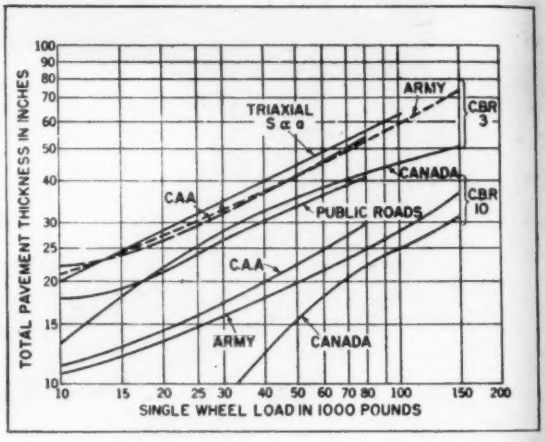
Engineering Data



Pavement thickness requirements by several methods.

Pavement Thickness for Airport Runways

The thickness requirements for flexible pavements for airport runways, as computed by five highly reliable methods, are shown in the accompanying chart, which was prepared by A. C. Benkleman of the Public Roads Administration. The curves shown on this chart are computed for two conditions of subgrades from formulas developed by the Corps of Engineers of the Army; the Public Roads Administration; the Civil Aeronautics Administration; and the Canadian Department of Transport. A thickness curve is also shown as would be developed by using the tri-axial shear test.

The two subgrade conditions are for a soil classified as CBR-10, a relatively good supporting soil; and CBR-3, a soil of extremely poor supporting power. Wheel loads are shown at the bottom of the chart.

Using any of these methods, a surface course 3 ins. thick and a base course 8 ins. thick would probably be used. The total depth of surface, base and sub-base required can be read from the chart. For a single wheel load of 80,000 pounds, total thickness by Army procedure would be 25 ins., by CAA, 30 ins.; and by Canada 22½ ins. The cost would not be markedly different for any of the three methods. With a CBR-3 soil, required depths would vary from 41 ins. for the Canadian method to 53 ins. by CAA.

Assuming unit sq. yd. costs of $1.08 for 3-inch surface; $1.20 for 8-inch base; and 5c per inch depth

When you need special information—consult the READERS' SERVICE DEPT. *on pages 77-81*

of sub-base, costs for CBR-10 conditions range from $2.86 to $3.23 per sq. yd. For CBR-3 conditions, using the same prices, costs will vary from $3.78 to $4.38 per sq. yd. These figures illustrate the fact that there are no sharp differences among these methods of design.

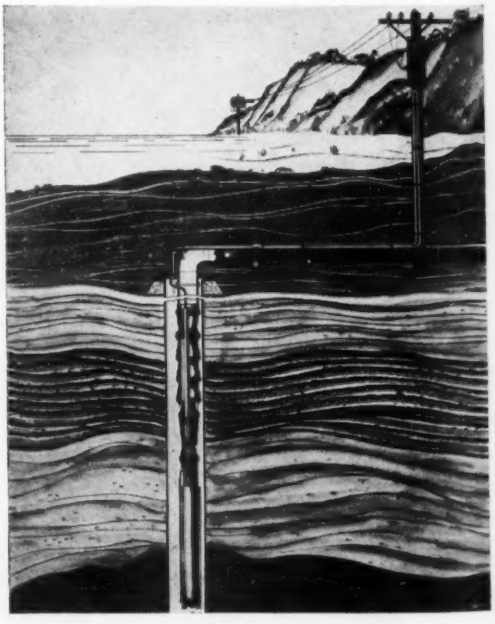
These data are based on material supplied by W. R. Macatee, manager of the Airport Division of the ARBA. Mr. Benkelman's paper was presented at a Highway Engineering Conference at the University of Utah.

Rubbish Can Advertising to Reduce Street Cleaning Costs

To remain within the budget, street cleaning in La Junta, Col., in 1948, was reduced to three times weekly in the business area. To augment income, rubbish cans were manufactured by City employees, using 55 gallon drums which were painted silver color. These cost the city $22 each. Each rubbish can has four advertising spaces and the city manager's office secured a yearly contract from one advertiser. When all the advertising space has been rented and the citizens become fully aware of the presence of the cans, it is anticipated that the cost of street cleaning will be reduced materially. Street cleaning required 4203 man hours and cost $3,362.40. Willard S. Conlon, city manager, recently resigned.

Submerged Pump Solves Unusual Problem

An unusual solution for a water supply problem near San Bernardino, Calif., was the location of a well for the Muscoy Mutual Water Co., in the middle of a creek. Much of the time the creek is dry. During normal rainfall, it carries a substantial volume of water. In floodtimes, erosion is serious. In the 1938 high water period, more than 20 ft of the creek bed was scoured away.



Submersible pump installed 15 ft. below creek bed.

In order to obtain water and insure protection against floods, the pump, which was a Byron Jackson Submersible, was mounted on a concrete foundation placed 15 ft. below normal creek bottom. The foundation was constructed like a pier for a bridge, narrow and pointed upstream. The pump discharge line ran underground and a marine cable, protected by a conduit, was used to convey the electric current. The pump is a 14-inch, 2,000-gpm. unit, pumping against a total head of 200 ft. It is coupled to a 4-pole, 440-volt, 60-cycle motor supplying 125 hp.

High-Intensity Airport Runway Lighting System

McCarran Field, the new Clark County Airport near Las Vegas, Nevada, has installed a high-intensity runway lighting system. This system was developed jointly by General Electric and the American Gas Accumulator Company.

Designated as a Class V Express Airport, it consists of two 6,500-foot paved runways, one graded runway, 16,100 linear feet of taxiway, 31,100 square yards of loading apron, and an administration building with approximately 27,750 square feet of floor space. The complete lighting system, including special equipment never before installed at an airport, was supplied by G.E. and installed by the Frank Electric Company of Hayward, California.

The Northeast-Southwest instrument runway, which is 150 feet wide and 6,500 feet long, is lighted by 72 high-intensity runway marker lights and 12 high-intensity green threshold lights, all complete with individual 200-watt isolating transformers. Each of the lights when used at capacity output is capable of producing in excess of 55,000 candle power of light.

One hundred elevated medium-intensity lights have been installed along the east-west runway and taxi entrances. Each uses a 40-watt isolating transformer. Other lighting fixtures include a 36-inch rotating beacon, an illuminated wind cone with hinged support, a movable controllable landing direction indicator, and an airport control panel.

A special static type regulator of 20 kilowatt capacity, never before used at an airport, was designed by G.E. to operate the runway lights. Duplicate controls, one located in the control tower and the other in the transformer vault, enable operators to control the field lighting from either location.

New Insecticides Tested on Mosquitoes in California Study

There are 35 species of mosquitoes in California of which 10 are considered fairly serious pests. No two of them show the same reaction to insecticides. This is the first finding in a survey of California mosquitoes, their habits and their control, made by Dr. Richard M. Bohart of the Entomology Division of the University of California College of Agriculture on the Davis campus.

The number of insecticides suggested for use against the insects is almost as numerous as the number of pests. Dr. Bohart has been trying to find out which insecticide is best against each species of mosquito. He is testing seven of the most promising on the larvae of 15 of the most disagreeable insects, in as many combinations as possible. Testing each material on groups of larvae, he intends to find out the amount of chemical which will in each case kill all, half of them and none.—California's Health.

PUBLIC WORKS DIGESTS

Sewerage

Water Supply

Highways and Airports

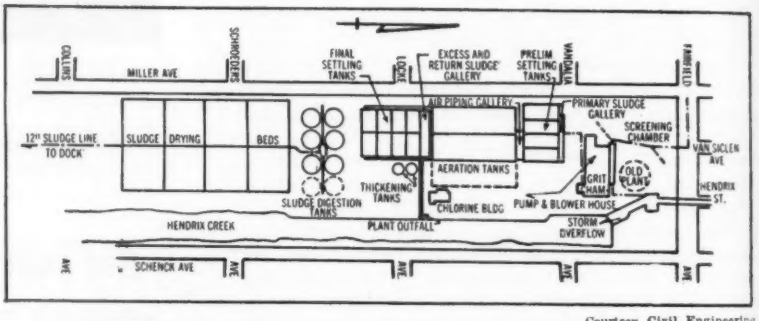
This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of all principal articles in these publications.

The Sewerage and Refuse Digest

New York City's Sewage Treatment Program

New York's program for modern sewage treatment, which was started in 1930, calls for 17 plants. Thirteen are now in operation treating 447 mgd, of which 6 old ones will be given up. Plans for nine new plants are under way or completed, and four other plants with a total capacity of 51 mgd are contemplated. Four types of treatment are to be employed—full treatment by activated sludge; simple sedimentation; sedimentation, supplemented by chemical coagulation and chlorination during the summer bathing season; and "modified aeration"—a high-rate activated sludge process. Sludge will be disposed of at sea. Sludge digestion tanks will be provided at all new plants, to minimize odors from handling the sludge and to reduce the amount of this to be handled; and the gas will be utilized to the greatest possible extent in producing power and heat.

Richard H. Gould—"New York Builds Two New Sewage Treatment Plants in Far Sighted Program"; *Civil Engineering*, January.



Courtesy Civil Engineering

Basic features of New York's 26th Ward activated sludge plant.

Velocities of Flow of Ground Garbage in Sewers

Tests have been conducted in the University of Texas to determine what velocities in sewers were adequate to transport ground kitchen wastes, and what materials in such garbage were most likely to cause trouble by deposits. A 60 ft. line of 8" vitrified pipe was set at 0.1, 0.2, 0.3 and 0.4% grades, and water flow kept at 0.2 to 0.4 of the full diameter. It was found that discharging such solids into sewer mains or trunks will cause no trouble if ample flow and velocity are maintained. Eggshells can be transported at an average rate of 0.14 ft. per min. by a mean water velocity of 0.68 f.p.s. The average discharge rate of water closets of 23 gpm produces sufficient flow to move deposits of ground garbage. It is evident that present design standards of 8" sewers are adequate should universal grinding of garbage be adopted.

Kenneth W. Cosens, Asst. Prof. of Civ. Eng., and Eric J. Hanemann, San. Engr.—"Sewer Velocities Required for Kitchen Ground Wastes"; *American City*, January.

Reasons for Adopting Activated Sludge

In Boise, Idaho, the southern part of the city is irrigated by canal, and in the summer irrigation season the ground water stands 2 to 5 ft. above the sewers. These, laid 40 yr. ago, are surcharged by infiltration through the joints, and the flow from less than 2500 people then averages 3½ mgd., and is therefore very dilute. The flow from the entire city averages 10 mgd in summer and 7 in winter. The flow in 1960 is estimated to be 12 mgd in summer, with a BOD of 120 ppm, and 9 mgd in winter with a BOD of 160 ppm.

The sewage discharges into the Boise river, the flow of which is so regulated by Arrow Rock dam, up stream, that the summer flow is relatively high and the winter flow very small. Therefore in winter the primary requirement is for BOD reduction and in summer for sterilization. Therefore the secondary processes of the proposed treatment plant were designed for 9 mgd, but will handle 12 mgd of the dilute summer flow satisfactorily. Assuming that single-stage high rate filters would reduce the BOD by 75%, and two-stage by 95%, there still would, part of the time, be less dissolved oxygen and nitrates in the effluent than would be needed, and the choice lay between standard-rate trickling filters and activated sludge. It was calculated that the annual cost of these two would be the same; and because it is practicable to locate an activated sludge plant nearer to built-up areas, and to operate it entirely free from odors or flies; and because the effluent is somewhat superior as to clarification, and easier to sterilize because of its lower solids content, the activated sludge type was recommended.

L. R. Howson—"Low Dilution Problems Dictate Activated Sludge for Boise"; *Sewage Works Engineering*, February.

Refuse Disposal By Fill and Cover

Riverside and Santa Monica, Calif., have discontinued burning refuse in open dumps because of the smoke nuisance, and have adopted fill-and-cover disposal. In Santa Monica, garbage is collected separately and fed to hogs. Cartons, waste paper, etc. are salvaged, tin cans are sent to a detinning plant. The rest of the rubbish is deposited in an old clay pit 30 to 40 ft. deep and 10 acres in area. The rubbish is deposited on the floor of the pit, salvable material removed, and the rest moved up the slope by a tractor equipped with a bullclam and spread over a 2:1 slope for a distance of 100 to 125 ft. from the pit bottom. The 26-ton tractor goes back and forth over this and compacts it, and at the end of each day the fresh deposit is covered with 4" to 6" of earth from the bottom of the pit. This method costs about $1 a ton. It was estimated that incineration would cost $3.50 per ton, amortizing the incinerator on a 30-yr. basis.

Riverside had, for 35 yr., disposed of rubbish and garbage on an open dump, which produced both smoke and rat nuisance. It was estimated that incineration would cost $1.25 more per ton than sanitary fill, and the latter was adopted more than a year ago. The old fill was leveled off, a trench dug along its west side and the refuse dumped into this and spread by a small bulldozer. Then a bullclam dug a trench east of this and spread the material over the fresh refuse; this second trench being used for deposits after the first had been filled, and the process repeated.

"Fill and Cover Disposal Curtails Smoke Nuisance." *Eng. News-Record*, Jan. 20.

Continuous Digester Feed

The plans for the Knoxville, Tenn., treatment plant, not yet under construction, provide for pumping sludge into the digester continuously at a uniform rate. To permit this, the sludge from the four settling tanks will be drawn off at intervals by sludge collectors into a sludge well, from which it will be pumped continuously by reciprocating sludge pumps.

By J. Benjamin Verhoek—"Knoxville's Sewerage Program Will Reduce River Pollution"; *American City*, January.

Incinerating Liquid Sludge

Ashland, Ohio, in 1939 built a sewage treatment plant which included 2 primary sedimentation tanks, a final settling tank, 2 sludge concentration tanks, a vacuum filtration unit, and a 4-hearth Nichols-Herreshoff furnace. Later the filtration plant was discontinued, two hearths added to the incinerator, and unfiltered sludge has been incinerated since 1941. Three gas burners are installed, one at each of the bottom three hearths. At the present time sludge is pumped once each day from each primary tank to one of the concentration tanks, from which supernatant is drawn off before the primary sludge is added. When a concentration tank is filled it is rested from 3 to 10 days, and sludge then removed from the bottom to the incinerator, the other tank being used meantime. During a 6-day test in 1947, the moisture content of the sludge ranged from 83.66% to 89.57%, averaging 84.99%. The test referred to was made for the Allegheny County Sanitary Authority. It was calculated that, for a sludge of 88% moisture, the cost for fuel would be $6.57 per ton of dry solids. The test seemed to demonstrate:

1. That unusually high concentrations of sludge are available under very ordinary circumstances.
2. That raw liquid sludge is being incinerated successfully at Ashland, Ohio, under ordinary conditions without highly specialized technical skill.
3. That compared with cost of sludge disposal elsewhere, especially in large plants, Ashland is incinerating liquid sludge satisfactorily at an economical cost.
4. If concentration of sludge can be accomplished to a moisture content of 88% as an average condition, the total cost of liquid sludge incinerator, includ-

ing supplementary fuel, in the Allegheny County Sanitary Authority Project, should compare very favorably with the total cost of sludge conditioning, dewatering and incineration as experienced at other large plants in the United States.

5. That designers of sludge incinerating equipment in our opinion can produce improvements which will make liquid sludge incineration more economical than is possible at Ashland.

6. Odors of incineration of sludge must be definitely controlled and eliminated.

J. F. Laboon — "Incineration of Liquid Sludge Proves Economical"; *Sewage Works. Engineering*, February.

Garbage Collection In Lansing, Mich.

In Lansing, city-owned garbage cans are furnished the user at a nominal rental, are collected by city crews, and hauled to the sewage treatment plant, where the garbage is raked to remove metal and stones, is ground and injected into digestion tanks through a pneumatic tube. The city has 21,990 9-gal. cans, and charges residences a rental of $3 per yr. per can with 50 cents discount for prompt payment. Collections from residences are made twice a week during July, August and September, once a week other months. Seven trucks are operated in winter and 12 in summer. Each picks up an average of 720 cans a day in three loads. Can covers are left at the houses. At the sewage plant the cans are washed with water at 190° temperature and distributed by the trucks as they collect the filled cans. The average life of a can is 3½ yrs. Last year the city collected 10,850 tons of garbage at a cost of $146,800. It received $57,900 from can rentals and $3,000 from sale of bones. The remaining cost is taken from the city's general funds.

"Garbage Collection In Lansing, Mich.;" *Eng. News-Record*, Dec. 23.

Sewer Rental At Belleville, Ill.

To provide funds for operating their sewage system and provide a financial background for issuing revenue bonds for improvements, Belleville has passed a sewer rental ordinance. The charges are based on water consumption. The city does not own its water supply, but the water company has agreed to furnish to the city the route books of their meter readers. The sewerage rental rates range from 20c per 100 cu. ft. for the first 13,000 cu. ft. to 6.6c for all over 134,000 cu. ft., with minimum monthly charges based on the size of the meter; and plus additional charges if the strength of sewage from any industry exceeds that of the domestic sewage. For every ppm of BOD by which a sewage exceeds 200, the rate is increased by 0.2%; and if the pH varies materially from 7.1, corrective measures must be taken, or the rental will be increased 25% or the service cut off.

Geo. S. Russell—"Sewer Rental Ordinance at Belleville, Ill."; *Sewage Works Engineering*, February.

Unusual Imhoff Tank Construction

Several Imhoff tanks have been built in Colorado which have the unusual feature of a wall dividing the sludge storage chamber into two equal parts. This wall is directly under the slot, and a gate at the bottom of the walls of the flowing-thru chamber permits diverting the sludge into either of the two storage chambers. When one is nearly full of sludge, the gate diverts the sediment into the other side and the first is allowed to digest. This gives better digested sludge, more gas for burning rubbish in the incinerator, and less sludge rising through the slot. Recently two plants have been built using corrugated Transite for the partition wall and for the walls of the flowing-thru chamber. It costs only ½ as much as reinforced concrete, is resistant to acids and alkalis and other adverse conditions; is easily worked, and occupies only 6% as much space in the tank as concrete.

V. A. Vaseen—"Economical Imhoff Tank Construction"; *Public Works*, February.

Garbage Collection In Canton, Ohio

A new sewage disposal project planned for Canton will include garbage grinding and digestion. For years Canton has collected garbage by taking the pails with the contained garbage to a hog farm, washing the pails and returning them to the customers. It now proposes to collect the garbage in enclosed bodies in the common fashion, but provide each truck with a washer capable of cleaning 450 to 500 cans each trip, returning the washed cans at once. The washer is built around a standard portable high-pressure vapor spray steam cleaning unit, which delivers hot water and steam at 100 lb. pressure. To utilize this fully, a "Christmas tree" spray was designed, consisting of a number of nozzles with jets 2" from the side and bottom of the can, which is revolved during washing. Washing for 10 sec. insures thorough cleaning. A unit of this kind has been in operation since May 1948, with a 6¼ cu. yd. enclosed refuse body, and a cleaning unit with enough water and fuel for one load. The city proposes to provide eight such trucks, fitted with 9½ and 13-cu. yd. refuse bodies, costing $8,000 and $9,500 each, respectively. With this new fleet, the over-all cost will be less than at present, the service will be more sanitary, and the collection units will be of improved appearance.

E. W. Galloway—"Canton Modernizes Garbage Collection"; *Eng. News-Record*, Feb. 3.

Nuclear Fission and Sanitary Engineering

In nuclear fission operations, highly radioactive materials are produced, which are hazardous to handle. The reactor is cooled by large quantities of air or water, which carries with it radioactive waste products. The safe disposal of these and other radioactive waste presents a difficult problem. At plants operated under the control of the Atomic Energy Commission, measures for protection of working personnel against overexposure to radioactivity usually are carried out by skilled technicians called health physicists, who also have given much consideration to the off-site problems involved when these wastes are released to the atmosphere, into the ground, or in surface areas.

One method utilizes the gradual decay of isotopes, which varies from potassium, which reaches half-life in 12.4 hr. to carbon, which requires 5,100 yrs. There is evidence that coagulation and sedimentation and sand filtration are quite effective in removing some radioactive substances from water. Apparently, radioactivity does not affect unfavorably many plankton growths, including algae, and is accumulated within them.

Sanitary engineers already need some guides as to relative degrees of radioactivity contamination, techniques for their measurements, and safe limits for

public safety and health. The radiologist and the health physicist have done much to develop such techniques, standards and equipment, and deserve much credit for their work along these lines. By means of instruments such as electroscopes, Geiger counters and ionization chambers, they evaluate the radioactive energy from nuclear particles, such as alpha and beta particles and gamma radiations. They have made much progress in developing instruments of increasing sensitivity and accuracy.

The authors place emphasis on the facts that:

(1) The continued expansion of the nuclear fission industry presents many problems and therefore, an opportunity and a challenge for the trained sanitary engineer; (2) the Atomic Energy Commission is striving actively for a permanent solution of its waste disposal problems; (3) its objective is that this new industry may expand to meet its potentialities without creating objectionable or hazardous conditions at and in the vicinity of its plants as many new industries have done; (4) sanitary engineers should be trained in fundamentals of nuclear physics so that they may have a better understanding of this new industry and its environmental problems; and (5) the need of training sanitary engineers is especially acute considering their responsibilities in a national defense program.

Arthur E. Gorman and Abel Wolman —"Nuclear Fission Operations and the Sanitary Engineer"; *Sewage Works Journal*, January.

Industrial Efforts For Stream Control

The author lists in this article presumably all activities for control of stream pollution conducted by trade associations and other organizations whose interests are restricted to a specific industry. It does not include technical societies or individual industrial concerns such as General Motors, Du Pont, etc. The industries served are *Brewing*, by the U. S. Brewers Foundation, Inc., *Canning*, by National Canners Assn., Tri-State Packers Assn., Florida Citrus Com'n., California Fish Canners Assn, Inc.; *Chemical Mfg.*, by the Maunfacturing Chemists Assn. of the U. S.; *Dairy Industry*, by Task Committee on Dairy Waste Disposal; *Electroplating*, by the American Electroplaters Society; *Gas Industry*, by the American Gas Assn.; *Meat Packing*, casually by the American Meat Institute; *Petroleum Industry*, by three committees of the American Petroleum Institute; *Pulp and Paper*, far ahead of any others through the National Council for Stream Improvement and the Sulphite Pulp Mfrs. Research League, Inc.; *Steel Industry*, by the American Iron and Steel Industry; *Tanning*, by the Tannery Waste Disposal Committee of Pennsylvania, the Tanners Council of America and the American Leather Chemists Ass'n.; *Textile Industry*, by the Textile Foundation, Inc. and the Institute of Textile Technology; *Wine Industry*, by the Wine Institute. There are no industry-wide programs for coal mining, distilling, rubber, wool, beetsugar and others.

Some of these programs have been conceived merely to mollify pollution control authorities, but the great majority are sincere. The types of activities undertaken include surveys of the pollution situation, research, education, exchange of information, liaison service, and advisory consultation to individual plants.

W. H. Wisely—"Stream Pollution Control Activities of Industrial Associations"; *Sewage Works Journal*, January.

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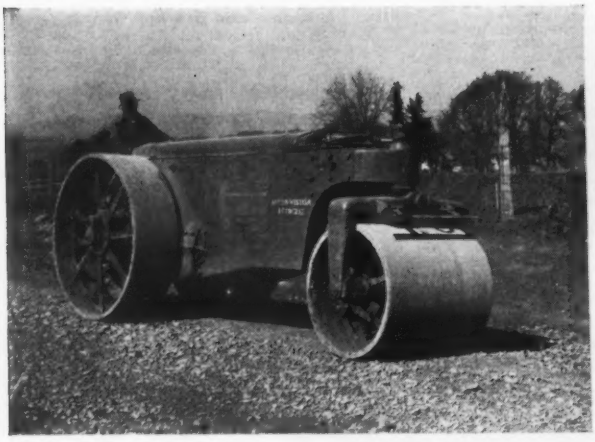
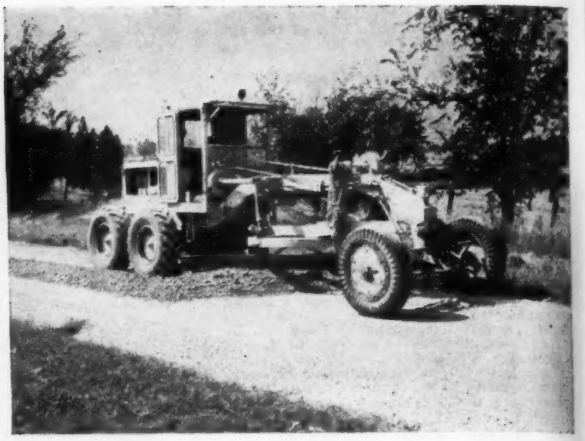
ASSOCIATIONS

The Maryland-Delaware Water and Sewerage Association will hold its 22nd annual meeting at the Alexander Hotel, Hagerstown, Md., April 28 and 29. E. Virginia Gipe, 2411 N. Charles St., Baltimore 18, Md., is secretary-treasurer.





Types of maintenance equipment that are used on oil mat work.

Laying an Oil Mat by Force Account

WALLY M. HECTOR

County Engineer, Klamath County, Oregon

ONE of the best oiling jobs done to date in Klamath County, Oregon, was accomplished in 1947 on a ten-mile section of road known as the South Poe Valley Road. This road is one of the main arterial farm-to-market County Roads and was one of the first outlying roads to receive a high type oil mat surface.

During the past many years this road has had various types of surfacing on different sections, including pit-run cinders, gravel and crushed rock. Before starting our oiling operation an additional four to six inches of crushed rock was put on, so, in all, over a period of years, there was perhaps an average of a foot of base rock placed on this road. On practically all of our County Roads, we require from nine to twelve inches of base rock before starting to oil. This is necessary, not only due to the heavy loads from farm produce and logging trucks, but also because we have cold winters here—always zero and below. A sufficient depth of base is necessary to keep the roads from breaking up in the spring.

Details of Construction

On this particular oil job, after the road bed was watered and shaped up, 10 yards per station of 1½" to ¾" crushed rock was laid down. This was just enough rock to cover the road approximately 1½" deep. After this rock was bladed to shape and rolled, an application of 0.4 gallon per square yard of SC-6 asphalt was applied by our distributor. This shot of oil was immediately covered with the same 1½" to ¾" rock at the rate of 8 cubic yards per station.

Next day this was tight-bladed, rolled and shot with 0.5 gallon per square yard of SC-6 asphalt, and covered with ¾" to ½" crushed rock at the rate of 5 cubic yards per station. (Two shots of oil were never put on the same piece of road the same day, but each shot was allowed to lay over night before tight-blading and rolling). The following day, after tight-blading and rolling, the ¾" to ½" rock was shot with 0.35 gallon per square yard of SC-6 asphalt and covered immediately with ½" to ¼" crushed rock at the rate of 2.7 cubic yards per station.

This work was accomplished between May 20 and June 14. During this time seven days were lost due to rain and approximately fourteen days were required to complete the work. Oil was not shot every working day, however, as part of the time had to be spent putting down the 1½" base rock on the first course prior to the first shot of oil.

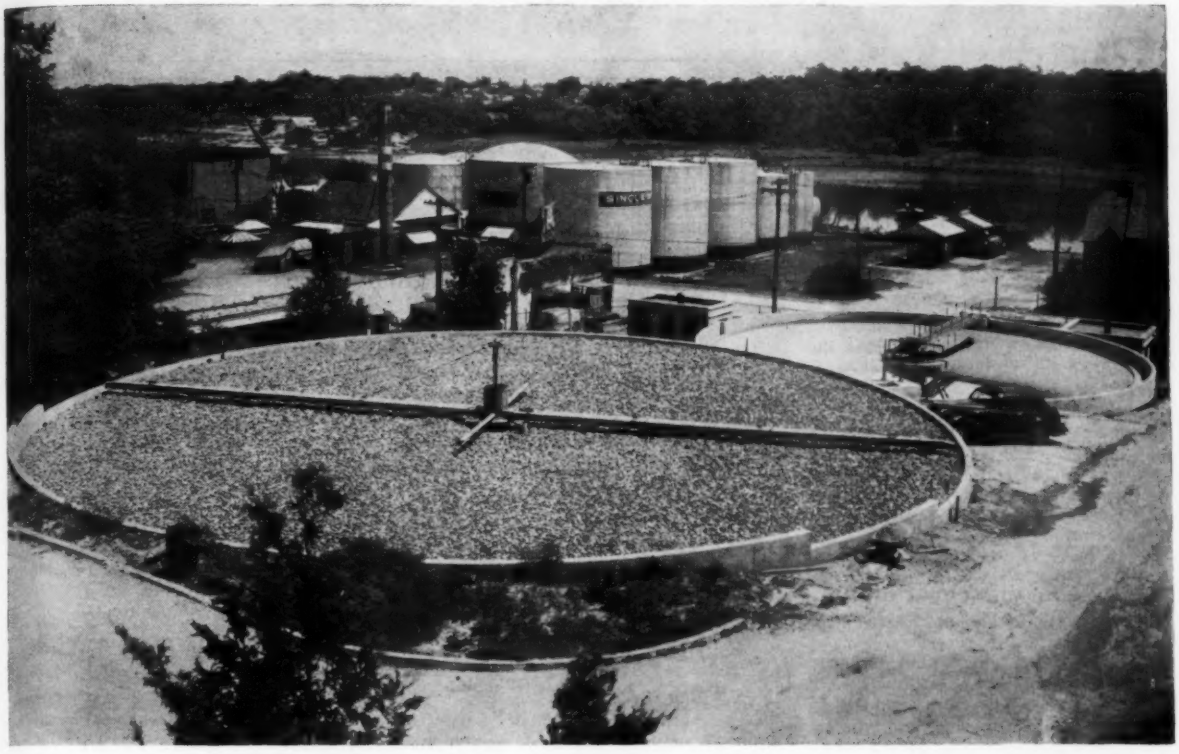
As there was other oiling to be done we were able to wait for about two weeks before coming back to this project for the seal coat which took about 2½ days to complete. During this two-week period the road was occasionally broomed with the regular steel broom fastened to the power blades. For the seal coat, RC-3 cutback asphalt was applied at the rate of 0.25 gallons per square yard and covered with ½" to ¼" crushed rock, as before at the rate of 2.7 cubic yards per station.

All of this work, including the crushing of the rock, was done with the regular County Road Department crew, under the supervision of Ed Propst, County Road Superintendent, and Wally M. Hector, County Engineer. The County Court for Klamath County are U. E. Reeder, County Judge; John R. Reber and Fred L. Pope, County Commissioners. The ten mile section of road was oiled for approximately $4,000 per mile, which includes the cost of materials, labor and equipment rental.

This road has stood up exceptionally well since it has received this oiled macadam surface. This spring, after going through last winter, which was rather severe on roads in this section, there was not a single break in its entire length. Also during the summers of 1947 and 1948 the road showed no signs of "bleeding."

Following is a list of equipment used on this job, all equipment being owned by the County: 1 Etnyre Distributor—1250 gallon capacity; 1 Cleaver-Brooks retort; 1 Cleaver-Brooks tank car heater; 2 Insulated transport tanks—1000 gallon capacity; 1 10-ton Hercules roller; 1 10-ton Austin Western roller; 2 No. 12 Caterpiller graders; 2 White dump trucks—5-yard capacity, and 10 Ford dump trucks—4-yard capacity.

TODAY'S FILTER PLANTS use *vitrified clay filter bottom blocks*



Designed by: *Clarence MacCallum, Port Washington, L. I., N. Y.*
Contractor: *DiMarco & Ciccone, Inc., White Plains, N. Y.*

Great Neck's New DORR Biofilter a fine example of modern design

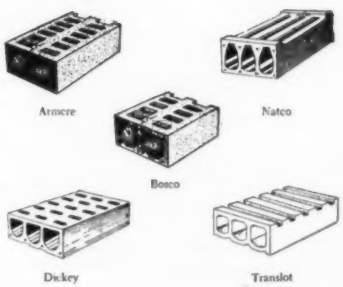
THE Dorr Company can point with justifiable pride to this fine example of Biofiltration serving part of the rapidly growing population of the village of Great Neck on Long Island sound. An average flow of 1.2 M.G.D. is handled by single stage Biofiltration employing a dual recirculation flow-sheet. Final effluent is discharged directly into Manhasset Bay.

Dorr equipment installed includes a 90′ dia. Dorrco Distributor in the foreground, a 65′ dia. Dorr S-7 Clarifier directly beyond, and a Dorr Multdigestion System with 35′ dia., primary and secondary tanks not shown. Another important feature of this modern plant is its underdrainage system built for life-time, trouble-free service of *Vitrified Clay Filter Bottom Blocks.*

These blocks made by members of the Trickling Filter Floor Institute are especially designed to provide the uniform ventilation and adequate drainage necessary in trickling filters of all types. Always insure best results by specifying *Vitrified Clay Filter Bottom Blocks.* Write any members of this institute for latest engineering data.

Here are some of the special advantages:

WON'T CLOG **LAST A LIFETIME**
EASY TO LAY **RESIST ACIDS**



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The Highway and Airport Digest

Ice Control by Radiant Heating

The Michigan Highway Dept. is trying out radiant heating as a method of ice control on two 500 ft. lengths of highway, one paved with portland cement concrete, the other with bituminous concrete on cement concrete. The heating elements were made by welding electrodes to the ends of 98-ft. sections of standard 2" square mesh sidewalk reinforcing 18" wide. Current will be controlled by thermostats, which will start it when the roadway reaches the freezing point and cut out when it rises to approximately 35°. The heating elements, one for each wheel track, were placed 1½" below surface of the roadway in the outside or passing lane. The cost of the 1,000 ft., including electrical equipment and controls, was about $2500; and the cost of electricity in normal winter weather with current flowing 50% of the time, is estimated to be 75c per hour. The low voltage used and the 1½" pavement as insulation will form protection against accidental shocks.

"Snow Removal by Radiant Heat"; *Public Works*, February, 32.

In Klamath Falls, Ore., a 450-ft. stretch of 4-lane pavement is being heated in a different way. In the pavement slab is embedded 15,000 ft. of ¼" pipe, made up into grids, one for each 30-ft. road panel. Each panel is connected to a 2" water main. Near by is a 10" well 390 ft. deep which struck water with a temperature of 190°. In this is submerged a coil of 2" pipe, and an anti-freeze solution is pumped through this coil and to and through the grids in the pavement and back to the well; entering the pavement grid at about 160°. The pump is thermostatically controlled by the air temperature. At the end of 1948 air temperatures had been down to 2° below zero, and one snowfall reached a depth of 7", but the pavement has been clear of snow and ice at all times.

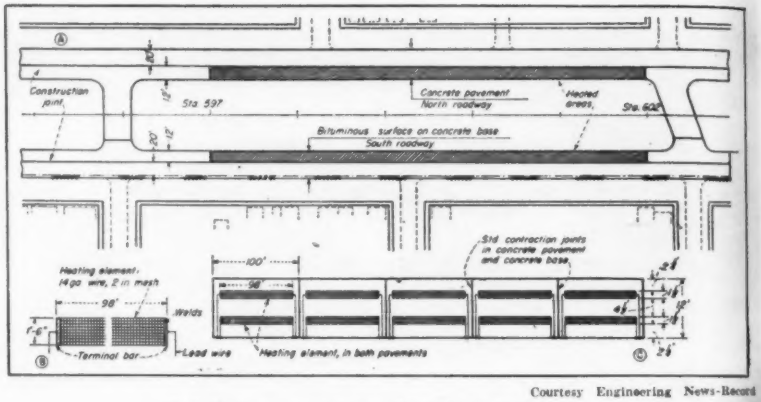
"Hot Water Heats Section of Oregon Route"; *Better Roads*, January.

Cleaning Roadside Ditches

Highway officials of twelve states contributed information on the subject of the most economical and satisfactory way of cleaning roadside ditches. Several referred to it as one of their most difficult maintenance problems. None was satisfied with any methods or equipment used, although almost all used some kind of equipment. This included power graders, front end loaders, force-feed loaders, bucket loaders and draglines. A Texas engineer said "These end loaders have reduced hand labor more than any other machine we have used lately." Oregon uses several truck-mounted units consisting of a slip handled by a swinging crane and drum on the end of the rear axle, thus avoiding the objectionable windrow caused by blading the material onto the side of the road.

No difficulty is found in disposing of the material. Some sell it to nearby property owners; others spread it onto adjacent farmland, use it for dressing the sides of fills, etc.

"Improving Roadside Ditch Cleaning"; *Better Roads*, January.



Courtesy Engineering News-Record

Details for pavement radiant heat installation.

The CBR Test for Flexible Pavements

Beginning in 1928 the California Division of Highways conducted investigations to devise a method of predicting the probable behavior of materials underlying a pavement and of establishing the density that should be used in the construction of subgrades and the shear strength required. These resulted in the development of the California bearing ratio test, the ratio being that between the resistance to penetration of the soil in question and the resistance of a standard crushed stone. Between 1940 and 1942 Army engineers studied the application of this test to the designing of pavements for air fields, with their heavier loads and other differences in usage, and developed modifications of the test. Thus modified, the test consists of forcing a 3 sq. in. circular piston into the soil and measuring the resistance to penetration, this resistance being compared to that of a standard high-bearing material. This ratio is used to determine, by design curves, the total thickness of base and pavement required to prevent shear deformation in the given subgrade soil for a specified wheel load. The test and curves have been developed to the point where they are considered very reliable. An entirely satisfactory method has not been developed for preparing laboratory specimens that will duplicate prototype conditions for all soils at all times, under all conditions and for all areas, and work on this is continuing. But the Corps of Engineers believes that this method is reasonable and satisfactory. However, the Corps has studies under way from which it is hoped that a completely rational design procedure may be developed.

W. J. Turnbull (in a summary of papers by fourteen other Army engineers)—"Development of CBR Flexible Pavement Design Method for Airports"; *Proceedings, Am. Soc. of Civil Engineers*, January.

Pushing Power Pays

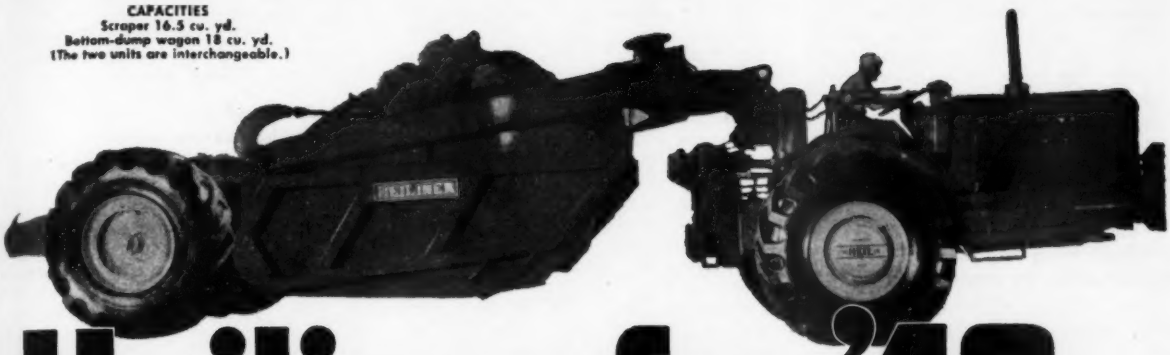
Generally speaking, one of the best methods developed by contractors to increase scraper production and lower costs has been the practice of push or snatch loading. The big scraper and its pusher tractor is generally preferred to double-bucket scrapers and tandem operation. This of course applies only to fleet operation, but on most jobs a pusher should pay for itself and on many will add materially to the profits. With a fleet of rubber-tired scrapers there can hardly be too much pushing power, to secure larger loads, or reduce loading time, or both.

D. K. Heiple—*"Does Pushloading Pay Off?"*; Roads and Streets, January.

Protection At Intersections

In rebuilding U. S. 66 across Illinois, special attention has been given to reducing hazards at intersections. Grades are separated at 5 crossings. At 9 where

CAPACITIES
Scraper 16.5 cu. yd.
Bottom-dump wagon 18 cu. yd.
(The two units are interchangeable.)



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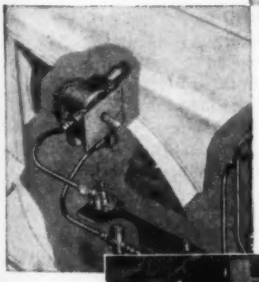
More Power... Moves More Dirt at Less Cost

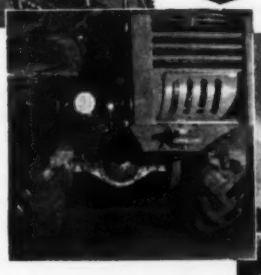
Heil's patented hydraulic Hydro-Steer lets your operator drive the Heiliner with the ease of a passenger car. This ease reduces fatigue, increases safety and maneuverability, results in faster haul-cycles.

The Heiliner's patented hydraulic pump delivers a constant volume of oil regardless of engine rpm. Steering is safe and positive at all times.



Heiliner drive-wheels carry 70% of the total vehicle weight, so as to make full use of the 200-hp engine. This gives you maximum traction and a top speed of 25 mph loaded.

Heiliners cut maintenance downtime and use it to move more dirt. Both rear-end and transmission can be removed without pulling the wheels. No propping or shoring is needed for this operation.



1. New 200-hp Cummins Diesel gives you plenty of power for lugging and for high top-speed.

2. HEIL'S patented, positive Hydro-Steer gives you passenger-car ease of handling... lets you make *more* round trips.

These and many other Heiliner features make dirt-moving more profitable. Get all the facts about the Heiliner and the complete line of Heil earthmoving equipment. Check the coupon below and mail it today.

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THE HEIL CO., Dept. 4439, 3044 W. Montana St., Milwaukee 1, Wis.

Please send me a bulletin describing all the many money-saving advantages of the amazing Heiliner.

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night accidents predominate, sodium-vapor lighting has been installed, supplemented at one by a flashing beacon, at another by vehicle-actuated traffic signals. The latter are used at a number of intersections where the volume of traffic is heavy on both highways. Flashing beacons have been installed at 20 intersections, suspended 15 ft. high over the centers of the pavements.

"Better Protection at Intersections"; *Better Roads*, January.

Programming Highway Construction by Annual Rating

The Arizona Highway Commission has developed a highway sufficiency rating system. The entire highway system is divided into sections about 5 mi. long, and each section is classified as to condition, safety, and service. Condition is allotted 35 points, 17 for structural adequacy, 13 for anticipated life (1 point for each year), and 5 for maintenance economy. Safety is allotted 30 points, 8 for roadway width, 7 for surface width, 10 for sight distance, and 5 for consistency (absence of abrupt surprises). Service is alloted 35 points, 12 for alignment, 8 for passing opportunity, and 5 each for surface width, sway in cross section, and roughness of texture. Thus a perfect road has 100 points. The rating system is not used as a decisive factor in determining priority of improvement, but traffic and terrain are considered also, and the human and political elements.

Wm. E. Willey—"Arizona Highway Program Based on Annual Rating"; *Eng. News-Record*, Jan. 20.

The Status of Soil Mechanics

The essence of soil mechanics is a compromise between the status of an exact science, such as the theory of structures, and that of an empirical one, like geology. The days when significant discoveries could be made in the laboratory or at the writing desk appear to be gone. Further progress depends chiefly on the improvements of methods for measurements in the field, on the scope and quality of the field observations, and on the adaption of the methods of subsoil exploration to practical requirements. We need, for each of the principal types of soils and of composite soil formations, a great number of complete and reliable case histories. These must be contributed by engineers in all parts of the world, each adapting the methods of subsoil exploration to the structural characteristics of the soil formations found at the sites of his activities. Only thus can we develop soil mechanics into an efficient tool for the practicing engineer. Field observations may be required to check theories and to detect important differences between the behavior of soils in the laboratory and in the field; for collecting information regarding such phenomena as the creep of clay under load, the gradual increase in the pressure of cohesive soils on rigid subsurface structures, or the consequences of disturbing the structure of fine-grain soils by pile driving; or to find out, during construction, whether the assumptions on which the design was based are reasonably correct.

Karl von Terzaghi—"Progress in Soil Mechanics"; *Roads and Bridges*, January.

Mechanical Vs. Hand Loading

Machine loading into 3-yd. trucks of material removed in cleaning ditches has been compared with hand loading on the basis of time of loading and cost of loading. Twenty tests in time studies showed the hand loading to require 3 to 25 times as long as by machine; and the cost to be 2 to 6 times as great. Also the machine capable of loading ditch materials can be used for many other purposes, such as loading aggregates or snow. The Virginia highway department uses 85 mechanical loaders. A great improvement would be a machine that would clean ditches and in the same operation load the material into trucks. Another desirable machine would be a mechanical bush and brush cutter that would work on a swivel, cut high and wide from a truck located on the shoulder, cut up brush and load it into a truck.

J. J. Forrer—"Mechanical vs. Hand Loading;" *Roads and Streets*, January.

"We (Oregon Highway Com'n) would like very much to have a piece of

equipment, something like a power grader or a force-feed loader that would load directly from the ditch into trucks without having to blade a windrow up on the shoulder. Such a unit would eliminate fouling of the shoulder rock, would eliminate the hazard of having a windrow on the shoulder, and we believe would reduce costs."

E. A. Collier—"Improving Roadside Ditch Cleaning"; *Better Roads*, January.

Scientific Designing Of Kansas Highways

Kansas Highway Commission employs "a close approach to a pure scientific method of design" of its roads, using a triaxial system of measuring the strength of soils, stabilized mixtures of soils and aggregates, crushed stones and bituminous mixtures. These stress-strain data, together with other substantiated data, are used in a formula which has been developed for giving a balanced design thickness for any flexible traffic-supporting layer. The factors embodied in the formula include modulus of deformation of the subgrade, and that of the mixture or stabilized layers; the base wheel load (9,000 lb. by state law); a traffic coefficient; a saturation coefficient (based on the local rainfall), the radius of area of tire contact; and the permitted deflection of the surface, valued at 0.1 in. The author shows in detail how this formula was used in designing two projects.

W. J. Arndt—"Highways Can be Tailor-Made"; *Better Roads*. January.

Sawing Concrete Sidewalks

Widening the roadway of a street in Racine, Wis., involved reducing the width of the concrete sidewalks from 8 ft. to 6 ft. This was done by removing a 2-ft. strip by means of a power-operated saw. This has a circular blade driven by a gasoline motor mounted on a 4-wheel frame, which was guided by hand along a chalk line marked on the sidewalk. A cut 2" deep was made and the excess concrete broken off with a sledge hammer. The cutting speed was 2 to 2½ f.p.m. The cost of a 2" cut averaged 37.7 ct. per lin. ft.

Wm. J. Chadwick—"Sawing Concrete Sidewalks;" *Roads and Streets*, December.

Preventing Lateral Movement of Fills

In widening and realigning 11 miles of U. S. 99 in California, the lack of stability in the geologic formation necessitated precaution to protect high fills against lateral movement. Heavy buttress fills were placed at the base. Cuts were built back on a slope of 1½ hor. to 1 vert. and at many critical points benches were excavated at the upper levels to relieve the weight. Before widening a fill, the outer surface of the old fill or hillside was scalped off and new fill was carefully tied in by dozers and sheepsfoot rollers. In one large fill, a 240-ft. length of 36" pipe was installed diagonally through it to collect ground water and lessen danger of slides.

"California's Heaviest Road Job!" *Roads and Streets*, December.

Rubber-Tired Earthmoving Equipment

Since 1932, scrapers with increasingly bigger, lower-pressure tires have utilized their tractor speed and power with increasing efficiency and economy. At first used only for long hauls on good roads, they have proved economical for short hauls and bad-going. One contractor on New York State road work made 15 loads per machine-hour with 200 ft. haul and less, moving blue gumbo, clay and quicksand in wet cuts and on steep hills. There are of course poor under-foot conditions that cut by 50% or more the hauling and return speeds of rubber-tired equipment. Low-pressure tires now available require that the soil have a minimum supporting value of only 15 to 20 psi, as compared to 8 to 12 lb. for crawler tractors. But soil worse than this is seldom encountered in work on roads, dams, airports and most other jobs. Even as tractor dozers, while their drawbar pull is only 60% or less of their weight, while that of track tractors may be 80%, the 60% is ample in probably 90% of the jobs, and the speed is an

advantage. In general, the speed and mobility of rubber-tired equipment cut non-productive moving time, and they can travel on any pavements without damaging them.

D. K. Heiple—"Can Equipment Speed Combat Rising Earthmoving Costs?"; *Eng. News-Record*, Jan. 6.

New Garage For Wyandot County

Wyandot Co., Ohio, has completed an excellent garage with several novel features. It is located on a 3½ acre site, giving room for expansion. The 80 x 180 ft. building contains an office, stock room, paint room, repair shop and wash room, which leave 10,720 sq. ft. for storage of equipment. From the bowstring truss roof is suspended a ceiling of ½" celotex 14 ft. above the floor. Probably the most unusual feature is the radiant heating. In constructing this a 6" layer of limestone was spread over the floor area, wet down and compacted. On this were placed two separate circulatory systems of wrought iron pipe, one for the large area, where the temperature is kept at 60°, the other for the repair shop and other rooms, to be kept at 65°-70°; each circuit controlled by its own thermostat. The pipes were covered with 6" of concrete. Heat is furnished by an oil-fired boiler. The radiant floor not only gives more comfortable working conditions, but it keeps the trucks warm so that they start easily. Even when brought in at night covered with snow and ice, this has all melted off in 30 minutes.

A. J. Moon—"Designing and Building a County Highway Garage"; *Public Works*, February.

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When you need special information—consult the **READERS' SERVICE DEPT.** *on pages 77-81*

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Fast Concreting in Kansas. By *J. B. Beuerlein*, Supt. Koss Construction Co., January, Pp. 35-38.

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Does Pushloading Pay Off? By *D. K. Heiple*, Engr. *R. G. Le Tourneau*. January, Pp. 42-43.

Mechanical vs. Hand Loading. By *J. J. Forrer*, Engr. Virginia H'way Dept. January, Pp. 47-48.

Airport Runway Base Construction with Emulsified Asphalt and Sand. By *V. L. Taylor*. January, Pp. 62, 77.

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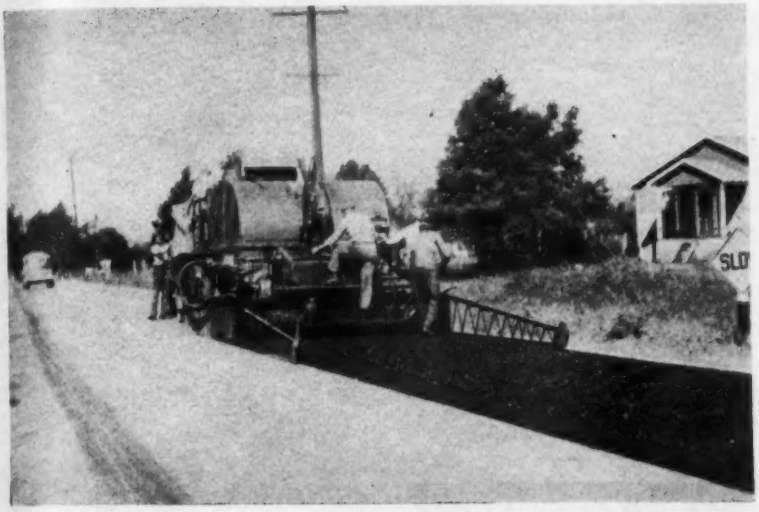
Stabilized Roads: Performance and Maintenance. By *Leonard John Murdock*. Jan. 28, P. 51.

Road Mixer Places Emulsified Asphalt for 26¢ per Sq. Yd.



Single course pavement being laid with one lane left open for traffic.

On a 26-mile resurfacing job in Tennessee, a Hetherington-Berner Moto-Paver was used with emulsified asphalt. The work was done by the Tennessee State Highway Department's Maintenance Division, on Route 64 from Wartrace to near Lewisburg.

The old roadbed, which was originally mixed-in-place, was left undisturbed to take advantage of the stability resulting from traffic compaction. In addition to the good base, drainage was excellent, but due to heavy traffic the road was rough, with rather high crown in sections. In order to correct these conditions, a leveling course was put down. This was followed by a finishing course which varied from an inch in the center to about four inches on the edge. Approximately one mile was completed each day, covering an 18-foot pavement in two passes.

During all operations, mixing and laying was continuous. Rolling and compaction was begun 45 minutes to an hour after laying. The finished surface was opened to traffic after a light application of screenings was dusted over the surface to prevent traffic pickup. Aggregate used was stockpiled midway on the job and hauled to the site. Top production ran about 750 tons per day, and required a little more than a tank car of emulsified asphalt. All work was completed under single lane traffic without rerouting. Approximate cost was 26¢ per square yard.

The limestone aggregate used was clean and sharp with very little dust. Tennessee #16 stone was used as follows:

Screen	% *Retained*
1"	0
¾"	0-3
⅜"	25-70
No. 4	80-100
No. 8	97-100

This gradation resulted in a more open mix than is ordinarily used. Tennessee #17 would have provided a denser and tighter surface, but was not available.

Emulsified asphalt type SS-1 was used as the binder for both the leveling and wearing surface and sufficient emulsion was used to give approximately 4½% by weight of asphaltic content.

The entire Bedford County project was under the jurisdiction of S. M. Squires, Division Engineer and J. B. Ramsey, Division Maintenance Engineer of Chattanooga. E. S. Ezell, District Maintenance Engineer supervised the daily operations, assisted by Foreman Campbell of the mixing operations.

Concrete Mixer Safety Rules

The following precautions are suggested by the National Safety Council in their "Construction Safety" bulletin.

Operation

1. To prevent tipping, set the mixer level. On a hill, block the wheels. Before you leave the mixer, land the skip, set the brakes, turn the switches off.
2. Before you start the engine, place the control in neutral. Run the engine for at least 5 minutes before you engage the clutch.
3. Make sure everyone is clear before you move the skip up or down.
4. To crank a motor, keep your thumb beside your fingers and pull up one-quarter turn.
5. Mark the mixer with a red cloth flag by day, a red light at night.
6. Keep away from the drum opening when the mixer engine is running.
7. When exposed to cement dust, wear a dust respirator and tight-fitting clothing.

Maintenance

1. Land the skip before you start to work on a mixer.
2. Before you move the mixer, fasten the safety chain or "hitch" securely.
3. Wear goggles when cleaning hardened concrete from drums. Stop the engine and lock it before you enter the drum.
4. Do not refuel the mixer engine when it is running or hot.
5. Use extreme care when adding water to a hot radiator.
6. Find out the cause of an engine backfire at once.

A.R.B.A.

At the 46th annual meeting of the American Road Builders' Ass'n., which was held in Washington, D. C., Feb. 7 to 9, Col. E. R. Needles was elected president. The four regional vice presidents are Paul B. Reinhold of Pittsburgh, Charles W. Smith of Florida, W. A. Roberts of Milwaukee, and T. E. Stanton of Sacramento. Jennings Randolph was elected treasurer to succeed the late Capt. H. C. Whitehurst.

Highway Costs

(Continued from page 21)

recting the critical deficiencies that existed at that time as $1,173,000,000, exclusive of right-of-way expenses, based on 1946 design standards and 1946 construction costs.

To bring both of the above up in line with 1948 construction costs, the 1940 and 1946 estimates will have to be expanded by the appropriate cost increase factor to make them comparable, as follows:

1940 estimated deficiencies = $512,000,000; 1948 price index (1940 = 100) = 216.8; $512,000,000 x 2.168 = $1,100,000,000 = 1948 cost of correcting 1940 deficiencies to 1940 design standards.

1946 estimated deficiencies = $1,173,000,000; 1948 price index (1946 = 100) = 216.8 ÷ 179.7 = 120.6; $1,173,000,000 x 1.206 = $1,415,000,000 = 1948 cost of correcting 1946 deficiencies to 1946 design standards.

Increased design standards are made necessary by the change in character, volume and weight of traffic since 1940. These changes require more lanes and heavier bases, pavements and structures than were contemplated in 1940. The unprecedented growth that has occurred in California since 1940 includes a population increase of 48.4%; a vehicle registration increase of 34.0%; a fuel consumption increase of 70.7% and a vehicle miles per day increase on the rural state highway system of 37.7%.

With proper corrections, taxable motor fuel consumed can be considered as a measure of total traffic on all roads and streets in the State. In 1940 the average motor vehicle in California consumed 581 gallons of fuel. In 1948 the fuel consumption per vehicle was estimated as 656 gallons or an increase of 75 gallons. While there has been a slight increase in the total miles traveled per vehicle per year, it has been estimated that two-thirds, or 50 gallons of the increased fuel consumption is due to decreased mileage per gallon.

This decreased mileage per gallon is due to a combination of increased average age and consequent decrease in efficiency of motor vehicles; and increased congestion in traffic, both rural and urban, particularly delays caused by the large increase in traffic signals installed since the end of the war.

By applying this decreased mileage factor to the 70.7% increase in motor fuel consumed, the increase in total traffic on all roads and streets in the State was determined to be 57.2%. The vehicle miles on the Rural State Highway System increased 37.7% in the same period. It is reasonable to assume that the increase for the whole State Highway System (Urban and Rural) is proportional to the total traffic increase in the State. It must then be concluded that traffic on the Urban State Highway System has nearly doubled.

This conclusion was reached in the following manner: the relationship between Urban and Rural State Highways was taken as 15% and 30% respectively of the total traffic in the state in 1940. This relationship was determined in 1934 and 1937 by the Highway Planning Survey and may be expressed as T = Urban State Highway Traffic and 2T = Rural State Highway Traffic, both in the year 1940. Then 3T = Total State Highway Traffic. Since we have assumed that Total State Highway Traffic has increased at the same rate as total traffic in the State, then in 1948 the Total State Highway Traffic would be:

3T x 1.572 = 4.716T. The 1948 Rural State Highway Traffic would then be: 2T x 1.377 = 2.754T. From this, the 1948 Urban State Highway Traffic would be: (4.716T — 2.754T) ÷ T = 1.962 or an increase of 96.2% since 1940.

If we accept the 1946 Estimated Deficiencies, which at 1948 prices amount to $1,415,000,000, exclusive of right of way costs, and assume that present prices will continue without change, the correction of present deficiencies would require 20 years with current revenues of around $70,000,000 per year.

If the assumption is made that the price structure will continue to rise indefinitely or that it will level off at a point as high or higher than it is now, then we are faced with the fact that the time of correcting deficiencies in the State highway system will be materially lengthened. If prices decline substantially and present revenues remain approximately the same, the highway construction program can be accelerated. If prices remain at present levels or continue to rise, the modernization of the highway system with its increasing traffic must proceed at a greatly reduced and inadequate rate.

The outlook is not very bright for early modernization of the California state highway system under present economic conditions.

When you need special information—consult the READERS' SERVICE DEPT. on pages 77-81

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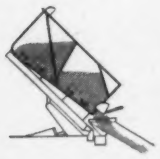

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The Water Works Digest

Water Supplies In the Arctics

In the arctic and subarctic, streams are frequently frozen solid in winter and are too highly laden with silt at other times to be practicable as sources of water supply. In many places, water is obtained by wells driven through the permafrost. Where the permafrost extends to great depths, water is obtained by melting ice in special melting plants. Water from wells often is high in iron and manganese, which is removed; and the water is generally chlorinated. It is seldom softened except for industrial processes, laundries and steam plants.

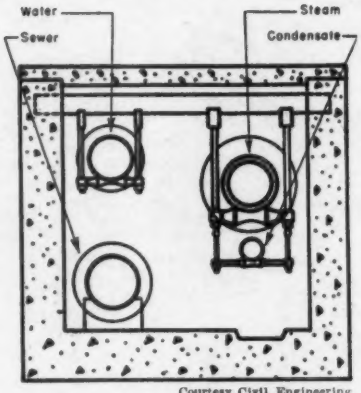
At arctic military bases, water, sewer and steam mains are carried in underground tunnels called "utilidors." (Steam is supplied from a central plant for heating all the buildings). For temporary buildings the utilidors are of wood, corrugated metal pipes, etc.; but for permanent installations reinforced concrete is used. Sufficient heat is supplied by the insulated steam mains to maintain above-freezing temperatures in the utilidor.

A so-called "conventional installation" consists of laying the pipes directly in the ground just below the seasonal frost line with gravel entirely surrounding them and covered with an 8" layer of peat. The water is preheated and kept constantly moving by circulating pumps. Sewers are laid with approximately 9 ft. of cover and are kept from freezing by bleeding steam condensate into the service stations. The first cost of the utilidor system is about 65% higher than that of the conventional system, and the service cost is more than 7% less. However, for a small community that does not have a central steam plant, the conventional system is more suitable, though more vulnerable to operational difficulties.

W. L. Hyland and M. H. Mellish—"Steam Heated Conduits—Utilidors—Protect Service Pipes from Freezing"; *Civil Engineering*, January.

Cone Valves in Distribution Systems

A rotary plug (cone) valve can be operated by one man to a full shut-off against a differential of the full design pressure of the valve. A long line of 60" pipe at Newark, N. J. contains three 48" gate valves which require 450 turns to close, operated by 6 or 8 men for an hour. A 24" cone valve installed in this line can be closed by one man in a few minutes. Smaller sizes of cone valves than of gate valves, with reducers, can be used because the former



Courtesy Civil Engineering

Box type utilidor of concrete.

present a smooth bore with no cavities or projections to cause hydraulic loss. Such loss is very slight if the increaser is long enough. The illustration shows an installation in the Newark pipe line. Unfortunately, cone valves cost many times as much as gate valves of the same size. Their use is therefore confined usually to strategic locations. Los Angeles places them so as to sectionalize the line properly and make possible a quick and sure shut-off if a break occurs. A cone valve can be operated by one man in a vault extended under the sidewalk, which is safer and interferes less with traffic than the operation of a gate valve from the surface.

Laurance E. Goit and Laurie M. Leedom—"The Use of Cone Valves in Distribution Systems"; *Am. W. W. Assn. Journal*, January.

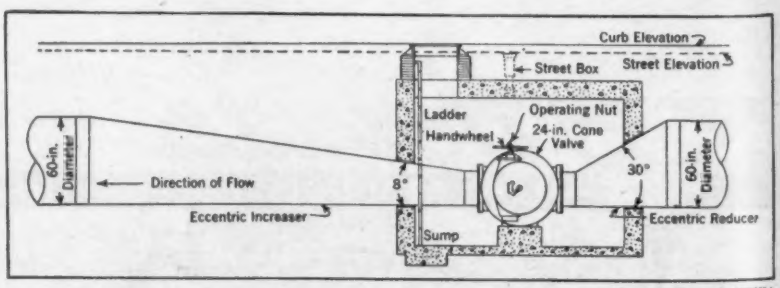
Regulation Of Water Rates

The basic theory of utility rate regulation is that each customer shall receive service at cost plus a reasonable profit. In actual practice the best that can be done is to group the customers into a limited number of classes and fix rates so that each *class* will pay its own costs. A theoretically sound rate should consist of three primary elements—customer charge, demand or capacity charge, and commodity charge. The first two can generally be combined into one part, and the commodity price graded into two or perhaps three steps. A straight commodity schedule, with a minimum bill provision, can be equitable only by accident, or rather by a miracle. For fire protection, the only measure of the cost of such service is the demand or capacity cost.

Paul L. Holland—"Regulation of Water Rates"; *Am. W. W. Ass'n Journal*, January.

Financing Extensions Of Distribution Systems

The revenue from an extension of a distribution system should be sufficient not only to finance the pipe and appurtenances but also to contribute its share of the cost of pumps, filters, reservoirs and all other parts of plant and property required to render service to the new consumers. How the author proposes doing this is most easily explained by assuming certain conditions for an imaginary plant. It is assumed that the gross revenue from the extension will average $15 a customer unit; that the records show that 60% of the revenue is used in operation and 40% to support the investment, and that 6% of the value of the property covers costs of borrowed money and reasonable profit. Then 40% of the $15 or $6, will be available to support the investment. Assume that 45% of the value of the plant is in the pipe lines alone; then only 45% of the $6 revenue should be used for financing the main extension at 6%. That is, $45 can be spent on the extension per customer unit. In an actual case, the records should furnish the exact figures for average revenue per consumer unit, percent of revenue used for operation, and the



Courtesy Journal AWWA

Cone valve installation.

percentage of the total value of the plant that has been invested in the distribution system.

Alfred O. Norris—"Financing Distribution System Extensions"; *Am. W. W. Ass'n Journal,* January.

Suggestions for Steel Pipe Lines

For main line valves, the common gate valve is the cheapest, but these are not suitable for throttling, for which square-bottom gate valves are preferable. Plug valves are easily operated under high pressure differentials. Cone valves need no lubrication; they are rather expensive but can be operated easily under extreme emergency conditions. A less expensive cylindrical, nonlubricated plug of single-seat style has been brought out recently. Hand-operated gate valves larger than 12" are geared; recently they have been made with the gears completely enclosed in a grease case, greatly reducing the energy required for operation.

If a valve is rigidly installed in a pipe line, as by flanged joints, there should be at least one flexible joint very close to the valve, to prevent it from being strained by temperature or other movements. Hub-end valves jointed with lead afford relief from strain; as do Dresser type couplings.

Large sizes of pipe with lap-welded joints will not hold the thrust of a closed valve, plug or angle, unless several joints near these be welded both inside and outside on the lap. Mechanical joints take no tension, and mains made up with them must be blocked at bends and valves. Most blocking and harnessing can be avoided in steel pipe work by generous use of welding. Changes or additions of appurtenances are made easily and quickly at any time, which is an important advantage of steel pipes over those of other materials.

Laurance E. Golt—"Steel Pipeline Appurtenances"; *Am. W. W. Assn. Journal,* January.

Mechanization of Water Utility Operations

The invention and use of mechanical appliances has been advanced greatly by scarcity of labor and increased wages. But the cost of mechanization is sometimes greater than is warranted by the frequency of use of the appliance. A number of appliances are described by the authors. One is a trenching equipment consisting of a rotary chain with cutting teeth carried by a large boom attached to a jeep; which cuts a trench 6" to 10" wide for a maximum depth of 5 ft. for services, at a rate of 100 ft. an hour. Pipe-pushing machines for installing services without digging had given trouble when stones or other obstructions were encountered, and an air-operated drifter drill is used for all types of soil, from sand to hard rock. In 1947 the American W. W. Co. installed 2505 services averaging 15.6 ft. long, using drifter drills, at a cost for labor $12,500 less than installation by digging. Other equipment includes a lifting crane on the rear of a service truck; a portable gasoline-driven generator, used for floodlights and for other electric equipment; among the latter being a wrench for operating large valves, and large tapping machines. A pipe finder and leak locator are almost necessary. Paint spray equipment is useful for painting hydrants and around pumping stations and purification plants. "The use of radio-telephone communication between the office and the company trucks and cars has been found very expensive," and they have substituted a much less expensive "signaling service" which gives an audible and visible signal to a truck carrying receiving appartus, the driver of which then calls the office from the nearest telephone; which service costs not over $16 a month. Another convenience is a distance-measuring wheel, costing about $100, which permits one man to measure distances in a fraction of the time required for two men using a chain.

James G. Carns, Jr. and W. D. Monie—"Mechanization of Water Utility Operations"; *Am. W. W. Assn. Journal,* January.

California Water Supply Standards

A codification of the California public health law in 1947 provides that additions or changes to a water distribution system must comply with standards

recommended by the California Section of the American Water Works Ass'n. That section a few weeks later appointed a special committee to draw up such standards. In the fall of 1948 the standards prepared by the committee were discussed, amended slightly, and adopted. These standards were considered of such importance that the entire text is published in the January "Journal" of the AWWA, with the suggestion that they be adopted by the association as tentative standards of safe practice. They apply to every feature of design as to quantity, they provide that "the combined capacities of all source facilities at periods of maximum demand shall support a rate of flow to the distribution system for two hours of not less than $Q = 100 + F\sqrt{N}$, for 623 customer units or less, and $Q = 100 + N$ for more than 625 customer units"; in which Q is rate of flow in gpm delivered; F is a factor equaling 25 (or less if approved by the State Dept. of Health for special cases); and N is the total number of customer units, each equivalent to one for a single family dwelling on a normal city lot.

The maximum run of a length of pipe in the distribution system is limited to 300 ft. of 2" to 2,600 ft. of 6" if the pipe is not fed from both ends; but if so connected, the minimum is extended to 600 ft. In no case are water pipes and sewers to be laid in the same trench.

"California Water Supply Standards"; *Am. W. W. Assn. Journal*, January.

Multiple Telemetering Over a Single Circuit

In developing a system for the control and supervision of the several booster pumping stations and an artesian well supply for the Washington Suburban Sanitary District, the engineers designed one that would record the water pressures on the low and high sides of the stations, and also the air temperature inside them, on 24-hr. charts. To avoid having to lease three circuits, they devised a means of transmitting signals from 3 transmitters simultaneously on a single pair of wires, using different frequencies of alternating current. But the telephone company announced that their charge for this would be as great as for 3 leased pairs of wire. The plan therefore was changed. One signal line is used, but it is connected automatically to each of the 3 transmitters in succession once every 5 min. for a period of 95 sec. Similarly, a receiver program timer connects each receiver to the signal lines once every 5 min. With the two synchronized, each transmitter is connected to its own receiver once every 5 min. This system is operating satisfactorily. Each station is inspected daily, except Saturdays and Sundays, by a single attendant, who keeps them clean, checks storage batteries, etc. The cost of pump operations has been reduced from $689.46 a month to $242.74.

John M. Jester and John W. Henderson—"Multiple Telemetering Over a Single Telephone Circuit." *Am. W. W. Assn. Journal*, January.

Soft Well Water For Softening Plant

Alliance, O., since 1945 has been improving its water plant, including remodeling the filtration plant to include softening. Four sand filters have been converted to zeolite softening units. In the new treatment, 75% of the water is overtreated with lime, then mixed with the remaining 25% of raw water and settled, then filtered through 8 rapid sand filters. After filtration, 40% of the water is circulated through 4 zeolite filter units and blended with the lime-softened water, giving a product of 90 ppm hardness.

Salt for regenerating the zeolite is obtained from salt deposits which underly the city. Rock salt is found at a depth of 3800 ft., and salt brine with a salt concentration of ¼ lb. per gallon at a depth of 600 ft. Use of the latter was chosen as costing less, and rises to within 90 ft. of the surface in a 7" well. This brine contains 32 ppm of iron, which is precipitated out by aeration and lime. The brine is then filtered through a small rapid sand filter and pumped to the zeolite filters as needed. The savings resulting from this method of obtaining salt have more than paid for the cost of the well dur-

ing the first year. When the hardness of the river water exceeds 230 to 250 ppm, the brine obtainable from the well is insufficient and is supplemented by purchased salt.

Donald D. Heffelfinger—"Savings Pay Cost of Salt Well for Softening Plant"; *Public Works*, February.

Chlorinating Wells Increases Yield

Chlorinating 8 wells at Long Beach, Calif. increased their yield from 4230 gpm to 8100 gpm. Best results were obtained by introducing chlorine at the rate of 175 lb. per 24 hr. in a 150 gpm stream of water, continuing this for 48 hr. and immediately pumping until the water cleared. Four or five cycles of such treatment were required. Cost averaged $300 per well. Not only was specific yield increased but production of sand was eliminated. The clogging was due to growths of crenothrix and other filamentous organisms, which were disintegrated by the treatment. By repeating the treatment annually, it is calculated that maintenance expense is reduced by at least 50%.

"Chlorinating and Pumping of Wells Increases Specific Yield"; *Eng. News-Record*, Feb. 3.

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Civil Engineering

Steam-Heated Conduits — Utilidors — Protect Service Pipes from Freezing. By *W. L. Hyland* and *M. H. Mellish*, partner and senior eng'r. Fay, Spofford & Thorndike. January, Pp. 27-29, 73.

Engineering News-Record

Timetable Financing for Tulsa Conduit. Jan. 20, Pp. 88-89.
Chlorinating and Pumping of Wells Increases Specific Yield. Feb. 3, Pp. 72-73.

La Technique de l'Eau (Belgium)

La Sterilisation par le Chlore et Ses Derives. By *M. Lucas*, Chemiste aux Laboratoires Reignier. January, Pp. 11-16.

New England Water Works Assn. Journal

A study of Sludge Disposal at Water Purification Plants in New England. By *Fred E. Smith*, Chemist, Cambridge, Mass., Water Dept. December, Pp. 265-274.
Standard Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs. January, Pp. 1-36.

Public Works

Studies for an Earthfill Dam. By *M. J. Shelton*, Chf. Engr., La Mesa, Lemon Grove & Spring Valley Irrigation Dist. February, P. 27.
Savings Pay Cost of Salt Well for Softening Plant. By *Donald D. Heffelfinger*, Engr.-Supt. Dept. of Water & Sewage, Alliance, Ohio. February, Pp. 33-34.
More Power for Gainesville, Fla. By *John R. Kelly*, Supt. Water & Light Dept., and *Wm. B. Crow*, Black Laboratories. February, Pp. 55-56.

The Surveyor (England)

Water Supply in 1948. Jan. 14, Pp. 23-24.

Water and Sewage Works

Financing Distribution System Extensions. By *Alfred O. Norris*, V. P. & Gen. Mgr., Birmingham, Ala., W. W. Co. February, Pp. 65-66.

Geologic Correlation and Hydrologic Interpretation of Water Analyses. By *T. E. Larson*, Illinois State Water Survey. February, Pp. 67-74.
Compressed Air Power Found Ideal in Hydrant and Valve Manufacture. By *E. C. Powers*, Compressed Air and Gas Institute. February, Pp. 75-77.
Purchasing Water Works Supplies and Services. By *Homer A. Hunter*, consulting engr. February, Pp. 81-82.
What Is a Satisfactory Water? By *A. E. Clark*, Mgr., Nashville Suburban Utility Dist. February, Pp. 83-84.

Water Works Engineering

Fast-Growing City Brings in 20 MGD Well. By *E. A. Roberts*, City Clerk, Carlsbad, N. Mex. January, Pp. 32-35.
Preliminary Fine Screens for London's New Filters. January, P. 36.
Thawing Frozen Services and Mains. January, Pp. 51, 66.

Cost of Street Repairs

In La Junta, Col., in 1948, 60,329 square yards of street repairs were made, and 14,823 man hours consumed, at a unit cost of $0.257 per square yard; 74% of the cost or $11,585.40 was for labor; 19% or $2,972.93 for material and 6% or $942.00 for transportation within the City. According to the City Manager, Willard S. Conlon, this unbalanced cost between labor and material is the result of inadequate equipment and is a matter which requires immediate attention in the interest of economical public service.

RAINFALL & RUNOFF

This book is by Edgar E. Foster of the Bureau of Reclamation. It contains 487 pages and 179 illustrations; price is $9. Contents include: Moisture and precipitation; air masses; storms producing precipitation; distribution of precipitation; frequency of rains; snow; evaporation; runoff; floods; ground water; and utilization of hydrologic data. There is a bibliography and also an index. Published by Macmillan Co., 60 Fifth Ave., New York 11, N. Y.

TRAILER PARK PLANNING

This booklet, issued by the Trailer Coach Mfrs. Ass'n., 20 North Wacker Drive, Chicago 6, Ill., gives a lot of information on planning trailer parks. Sections include: Important factors in a successful trailer park; selecting a location and nine points to consider; adequate facilities; building requirements; estimating costs; and profit expectancy. Sample layouts are given. Blueprints and other information are available on request.

ODORS-PHYSIOLOGY & CONTROL

Odor perception, measurement, classification and regulation are covered in this book which presents "a valuable working knowledge of olfactory physiology and anatomy, the hedonics of odors, and the legal aspects of odor control." It outlines a number of practical methods that can be used in eliminating odors from factories, homes and public buildings. It should be of particular value to public health officials and sewage disposal engineers. By Carey P. McCord and William N. Witheredge. McGraw-Hill Book Co., 330 West 42nd St., New York 18. N. Y. Price is $6.50.

GOLF FACILITIES

This 80-page book tells what you ought to know about organizing, planning, building and maintaining a golf club or golf course. Essential data include: Planning and building the course; watering; landscaping; sand green construction; grass maintenance; planning the clubhouse; and maintenance. Numerous illustrations show layout, grading, drainage, and construction details. Cost is $2. National Golf Foundation, 407 South Dearborn St., Chicago 5, Ill.

TRUCK & TRAILER REQUIREMENTS

The size and weight restrictions on trucks and trailers, for all states, are presented in this booklet. One page is devoted to each of the 48 states. Data include size restrictions—width, height, length of single unit, semi-trailer and other combinations — minimum axle spacing, weight per axle or per wheel, etc. Sent on request to Four-Wheel Drive Auto Co., Clintonville, Wisc.

Milwaukee May Add Fluorine to Water

JOHN E. HUBEL

AFTER lengthy studies of the effect of the addition of fluorine to drinking water, the Milwaukee common council has decided to ask the Wisconsin legislature for authority to do this. If such legislation is passed at the present session of the Wisconsin legislature, further inquiry will be made to determine the approximate cost of such fluorination. At present it is estimated that it would cost the city about $100,000 per year. The city attorney's office has held that such expense cannot be authorized at this time, without special legislation for the raising of funds, as no money is available now for this additional expense The mayor and common council have decided that such a sum could not be taken out of the Milwaukee water department funds.

In discussing the prospect of adding fluorine to the city's drinking water, to help in the preservation of the teeth of children of the area in which the water from the Milwaukee water works is distributed, Dr. E. R. Krumbiegel, head of the city health department, stated that ten million persons now live in sections of this country in which fluorine has been added to water, and that where fluorine is added to drinking water in proper amounts, there has been a decrease of 60% in dental decay. The usual amount of fluorine added is one ppm. In one Wisconsin city, it is said, 2½ ppm of fluorine is normally present in the water from city wells.

The acting superintendent of Milwaukee's water works, Edward Tangue, believes it would be improper to use Milwaukee water department funds temporarily to start the fluorine program. He suggested that the common council wait, even after an appropriation has been set aside for the purpose, until the experiments which the United States authorities are now conducting at Grand Rapids, Mich., have been completed and the results have been made known. The main benefits of fluorination appear to apply to children up to 12 years of age.

Wood By-Products for Soil Improvement

Sawdust, wood chips, shavings and woody plant stems may be a valuable source of soil organic matter according to A. C. McIntyre of the Soil Conservation Service. His findings, presented at the recent meeting of the Highway Research Board, showed that wood contains large percentages of lignin which is broken down into a humus much longer lasting than humus derived from the bacterial destruction of plowed-under green manure crops. Mulches derived from wood can be cheaply manufactured by portable "hogs" and grinders now available.

Heavy sawdust or wood shaving mulches have been used in improving soils and increasing the production of orchard crops. Woody types of mulches are effective in preventing erosion. Such mulches can be obtained at costs averaging from $2 to $5 per ton as compared with much higher costs of other commonly used mulching materials.

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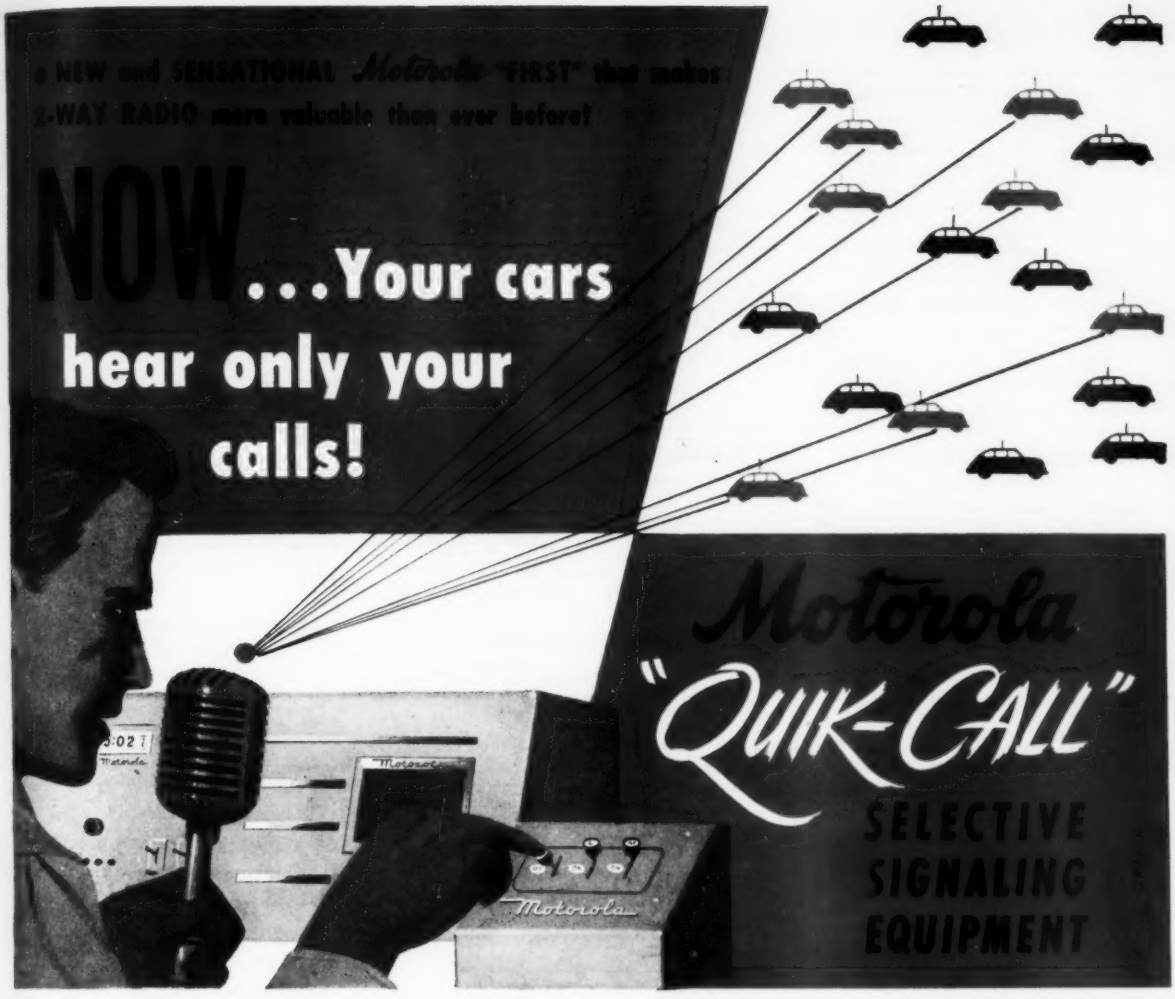

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PUBLIC WORKS Equipment News

Rubber Cones Make Traffic Safer Than Barricades

These new rubber "trafficones" are invaluable in guiding and directing traffic. They have the appearance of

This illustration shows Enterprise trafficones directing traffic, but they are especially useful and labor-saving as barricades, in which their powerful appearance is an asset.

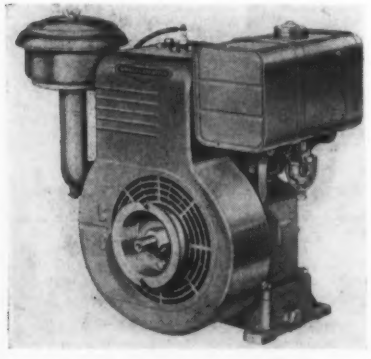
steel, but are of safe, collapsible rubber; they are durable, light in weight and can be set up much more quickly than barricades. Because they are hollow, they stack readily and permit storage in a minimum space. The pictures show how these cones can be used for separating lines of traffic. *Enterprise Development Corp., Burbank, Calif.*

Use coupon on page 77; write in No. 3-1

Useful Small Gasoline Engines

Three new models of Briggs & Stratton engines have been announced. These are: Model 9, 2.16 to 3.1 hp; Model 14, 3.56 to 5.1 hp.; and Model 23, 6.5 to 8.25 hp. Among the new features is the magnematic ignition system. Detailed specifications and power curves can be obtained by writing *Briggs & Stratton Corp., Milwaukee, Wisc.*

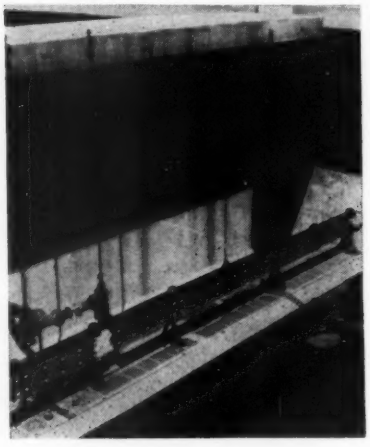
Use coupon on page 77; write in No. 3-2



Briggs & Stratton small engine.

Preaeration for Improved Primary Sewage Treatment

A marked improvement in primary treatment can be accomplished by adding a preaeration stage without expensive alterations to existing sewage treatment plants. This preaeration provides agitation and mixing and adds oxygen; it conditions the solids so that improved



PFT Preaeration unit.

settling results, with increased removal of BOD and SS. Full details of this improved method of treatment can be obtained from *Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.*

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For Warning of Gas Hazards

A brilliant red light flashes when a dangerous concentration of combustible gases is present, warning workers in vaults or manholes of danger. The unit is completely portable and self-contained. Ask for Bull. DT-4. *Mine Safety Appliances Co., Pittsburgh 8, Pa.*

Use coupon on page 77; write in No. 3-4

Front End Loaders for Graders

Designed to produce more effective and productive time from power graders, this new unit can be attached to

M-B front end loader.

M-B graders and maintainers. The loader has a half-yard bucket for handling dirt, sand, gravel and similar materials; a one-yard bucket is also available for light and bulky materials. Operation is independent of the grader blade, scarifier or leaning wheels, and is by a single lever. After initial installation, mounting requires 30 minutes. Full data from *Meili-Blumberg Corp., New Holstein, Wisc.*

Use coupon on page 77; write in No. 3-5

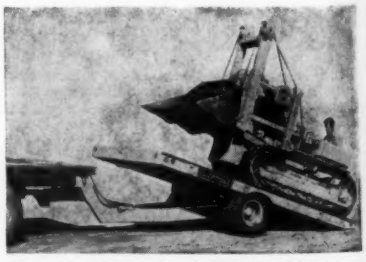
A Big-Capacity Centrifugal Pump

This pump is useful for handling wash water for filters, for raw water pumping, for sewage disposal and sewage handling, and for big dewatering jobs. It will deliver 180,000 gals. per hour at 35 ft. TDH with its 30 hp. engine. It is side suction, with exhaust priming. Folder describes pump and contains performance curves. Ask for Form 81R-12. *Gorman-Rupp Co., Mansfield, Ohio.*

Use coupon on page 77; write in No. 3-6

Handy Trailer for City and County Work

For handling and hauling concrete mixers, tractors, air compressors and tools, as well as bulky loads, an 8 to 10-ton trailer is available. This is tilt-



La Crosse trailer loading.

ing for easy loading. Has electric brakes, safety chains, lashing rings, lights and reflectors. Weighs 3950 lbs. *LaCrosse Trailer Corp., LaCrosse, Wisc.*

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A New Type Electric Paving Breaker

An 84-pound electrically operated high-cycle pavement breaker and a 129-pound dual voltage gasoline engine driven generator make a new-type paving breaker combination. They can be carried in the back of a car or in a light truck. The generator can be used for operating other tools and for floodlighting. For a description of the mechancial features of this new unit, write *Homelite Corp., Port Chester, N. Y.*

Homelite electric breaker.

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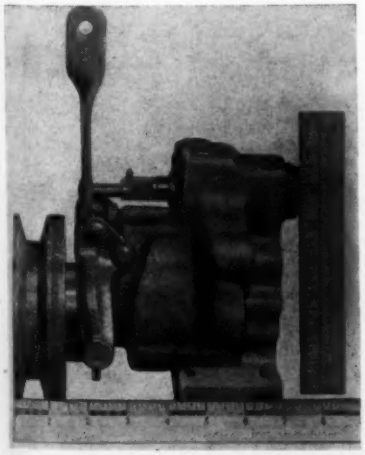
Hydraulic Clutch-Type Power Pump

This pump is designed for using hydraulic power, where applications are desired for periodic short lengths of time. It operates only when power is needed. Especially adapted for quick conversion of road and construction machinery from manual to hydraulic control—snow plow, bulldozer, dump body, scraper, etc. Full data from *Waukesha Hydraulic Corp., Dept. 1286, Box 414, Waukesha, Wisc.*



Waukesha hydraulic unit.

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Grease and Root Cutter to Unclog Sewers

By means of a geared transmission, this sewer cleaning unit drives a rotating cable through pipes as small as 4-inch. It is guaranteed to make quarter-bends in 4-inch pipe. Cutter blades and finishers are provided. It will handle pipe up to 12-inch and up to 500 ft. of stoppage. *Miller Sewer Rod Co., 4638 North Central Ave., Chicago 30, Ill.*

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This flexible template can be set and locked to duplicate any curve. Available in 2-ft. and longer sections. Suitable for contours, pipe bending, conduit curving, form building, and any other work requiring duplication of curva-

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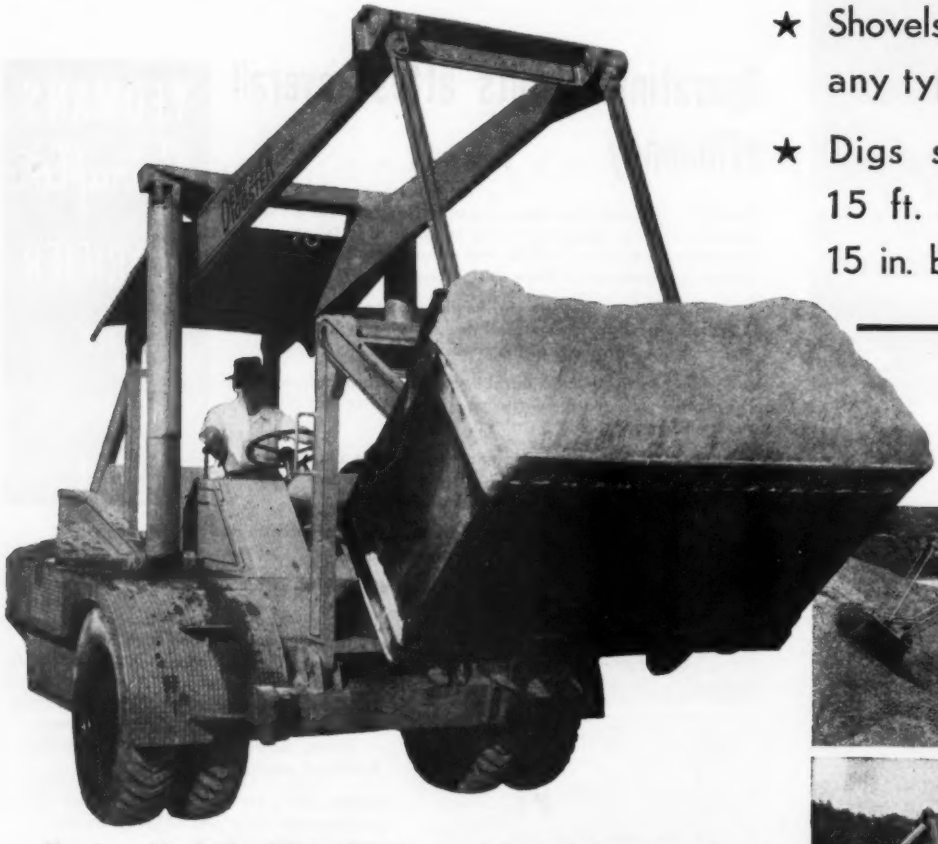

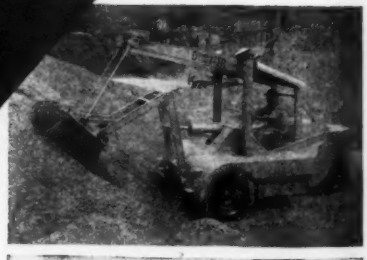

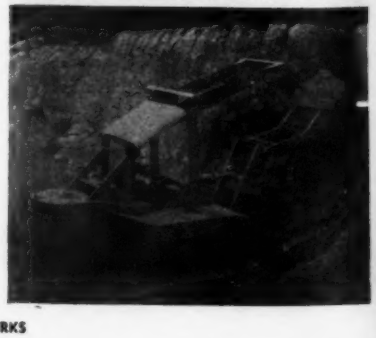

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Large photo above shows close-up of Dempster-Diggster with 1½ cu. yd. digging bucket loaded. At right, top: Loading crushed stone. Center: Diggster dumps crushed stone into truck. Right, bottom: Digging out a high bank.

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ture. After locking, can be transferred anywhere; when unlocked, returns to its original position. Spring steel and aluminum construction. *Clark & Poggenburg, 4900 Wynnfield Ave., Philadelphia 31, Pa.*

Use coupon on page 77; write in No. 3-11

Indestructible Road Markers

Road markers, made from Bakelite polyethylene, are available in various colors to suit highway or street departments. These are in the shape of small pyramids and will stand abuse, truck traffic, etc., without breaking or losing their shape. These are made by *Plastic Engineering, Inc., 8506 Lake Ave., Cleveland 2, Ohio.*

Use coupon on page 77; write in No. 3-12

Power Driven Bow Saw for Small Timber

This 20-inch bow saw, with a 5-hp. motor weighs only 63 pounds and is especially designed for cutting small timber. It will cut through any type of wood, whether flat on the ground, propped at one or both ends, or swinging. The bow saw can be interchanged with other chain saw models. *McCulloch Motors Corp., 6101 W. Century Blvd., Los Angeles, Calif.*

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Speed Finish for Concrete

A speed finish for concrete walls, new or old, interior or exterior, has been developed, which is applied easily with a cork float. The exterior finish is applied in two coats. The first or bond coat fills voids and smooths the wall; the finish coat gives a smooth waterproof surface. The interior finish is a special powder which does not require a bond coat, but leaves the surface plaster-smooth. *Irvington Form & Tank Corp., Irvington, N. J.*

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Faster One-Man Digging in Hard Soil

The electric "ground hog" is designed to break frozen ground quickly and dig through hard clay or shale. It is small enough so that two men can work together, one man operating the tool and the other shoveling. Weighs 32½ pounds; electrically operated; easily portable; includes frost wedge, spade and tamper. *Turf Equipment, Inc., 211 McElroy St., Minneapolis 8, Minn.*

Use coupon on page 77; write in No. 3-15

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How to Beat the Weed Problem

85. Be sure to investigate weed control with selective chemical weed killers. Ask for bulletins on Dolge products that will rid roadsides, parks and lawns of the weed nuisance. C. B. Dolge Co., Dept. PW, Westport, Conn.

Vitrified, Salt Glazed Filter Bed Block

86. An 8-page folder contains instructive design applications and detailed descriptions of Dickey underdrain tile for filter bed bottoms. Diagrams show how air passes up through blocks for filter ventilation. Issued by W. S. Dickey Clay Mfg. Co., 922 Walnut St., Kansas City 6, Mo.

Easily Cleaned, Long Run Filter Bed Media

140. Bulletins on Anthrafilt tell the reasons why selected, graded crushed anthracite is superior to sand as a filtering material. Have you made a full investigation? Write Anthracite Equipment Corp., Wilkes-Barre, Pa.

Turbidity Measurements Without Special Standards

141. The Hellige Turbidimeter is designed to avoid tedious suspension standards preparations and provide accuracy in the lower ranges by using the Tyndall Effect. Catalog 8000 shows exactly how this instrument operates and how it is used. Write Hellige, Inc., Dept. PW, 3718 Northern Blvd., Long Island City 1, N. Y.

For Speedy Bituminous Maintenance Jobs

142. The Standard Steel trailer-mounted pressure distributor and tank is easy to move for emergency patching, all maintenance. Write for bulletin "S-J" on this fast acting, low cost equipment. Standard Steel Works, Dept. PW, North Kansas City, Mo.

Diesel Engines With Opposed Pistons

143. The opposed-piston idea is joined with principles of diesel combustion to provide economical operation in municipal, private utility and commercial power plant applications. You'll find colorful, detailed data on this remarkable diesel engine in Bulletin 3800D-1, Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.

Paint for Protection And Good Appearance

144. An 8-page bulletin describes 14 different uses for "Inertol" products in water works for protecting and waterproofing concrete, steel and wood structures. Get data on these paints and enamels from Inertol Co., Inc., 470 Frelinghuysen Ave., Newark 5, N. J.

Standard Translot Blocks For Filter Underdrains

145. Proper filter underdrainage is extremely important. Specifications and installation details for transverse slot filter underdrains made of durable vitrified clay are available from Texas Vitrified Pipe Co., Mineral Wells, Texas.

Quick Cleaning for Clogged Sewers

146. Investigate these electric-powered cutters for cleaning sewers and drainlines clogged with grease, roots, sand and leaves. Units designed for 4" to 6" sewers, 8" to 12" sewers. Write Miller Sewer Rod Co., 4638 No. Central Ave., Chicago 30, Ill.

Durable Gratings and Treads Are a Good Investment

147. Gratings for walks around settling tanks and other parts of treatment plants, both out-doors and in, for stairways, floors and balconies, are described in an illustrated 16-page bulletin by Irving Subway Grating Co., 5053 27th St., Long Island City 1, N. Y.

Faster Pipe Laying With Precaulked and Threaded Joints

148. McWane 2" cast iron water pipe with threaded joints and precaulked bell and spigot pipe are described in folder WM-47. Additional data on 3" to 12" centrifugally cast pipe and fittings in folder WL-47, both issued by McWane Cast Iron Pipe Co., Birmingham 2, Ala.

High-Speed Dirt Moving Means Lower Costs

149. The '49 Heiliner combines a powerful diesel engine, easy handling hydraulic steering to speed up dirt moving with interchangeable scraper and bottom dump wagon. To learn all the money-saving advantages get bulletin RM 48031 from The Heil Co., Dept. 4439, 3044 W. Montana St., Milwaukee 1, Wisc.

STREETS AND HIGHWAYS

Strong, Speedy, Low-Cost Maintainer Has Many Uses

22. BG Maintainer, a powerful speedy, low-priced machine for light road maintenance. Full details in illustrated folder. Huber Mfg. Co., Dept. PW., Marion, Ohio.

Useful Attachments For Your Industrial Tractor

24. Need a front end bucket loader that can be converted into a light plow or grader in a matter of minutes? Write for this folder that illustrates, describes and gives specifications of the Ottawa Industrial Front End Loader for industrial tractors. Loads earth, sand, gravel and other bulk material. Quick change over can be made to light bulldozer, V-type snow plow, grader or maintainer with attachments. Write Dept. PW, Ottawa Steel Products, Inc., Ottawa, Kans.

Solve Your Drainage Problems This Easy, Permanent Way

28. Useful new 60 page catalog on standard corrugated pipe, multi-plate pipe and arches and 18 other drainage and related products for culverts, sewers, subdrains, flood control, airports, water supply and other types of construction. Ask for "Armco Products for Engineering Construction." Armco Drainage and Metal Products, Inc., Dept. PW, Middletown, Ohio.

For a Good Job of Sand And Gravel Spreading

46. Two models of Flink Spreaders are controlled from cab, handle all granular materials. Spreaders are easily installed and do not interfere with dumping. Hydraulic gate control automatically closes gate when spreader is stopped. Get Bulletin M6, Dept. PW, Flink Co., Streator, Ill.

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107	111	112	115	116	118	121	122	123	124	125
126	129	130	133	136	138	140	141	142	143	144
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Others (See page 73)_____

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THIS COUPON NOT GOOD AFTER APRIL 30th

Data on All Types of Bins and Batching Plants

47. Good illustrations and useful data on all types of Heltzel Highway Bins, for truck mixer charging, bulk cement plants, enclosed bucket elevators, belt conveyors, etc. Heltzel Steel Form & Iron Co., Dept. P.W., Warren, O.

Speed Your Work With These Powerful Motor Graders

48. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Latest Maintenance Equipment For Blacktop Roads

52. "Blacktop Road Maintenance and Construction Equipment" — Asphalt and tar kettles, flue type kettles, spray attachments, tool heaters, surface heaters, road brooms and rollers. This is modern and up-to-date equipment for blacktop airport and road construction and maintenance. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati 2, Ohio.

Tractors for Counties, Cities and Contractors

76. An attractive 24-page catalog portrays the Allis-Chalmers HD-5 crawler's abundant capacity and ability to meet the variable needs of counties, townships and contractors. Photographs and cutaway views illustrate its rugged construction and simplified maintenance. Use coupon or write Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee 1, Wisc.

Just Right for Fast, Small Asphalt Mixes

90. The Foote Kinetic Mixer delivers 3 cu. ft. in 30 seconds. Portable and easily operated. Get Bulletin K-100 from The Foote Co., 1954 State St., Nunda, N. Y.

Grading Can Be Faster, Cheaper and Easier

96. You'll like every feature of the Austin-Western 99H Grader. It has all-wheel drive, all-wheel steer, controlled traction, precision sideshift and a high lift, extreme reach, reversible blade. Get data from Austin-Western Co., Aurora, Ill.

Light Weight Machine Does Work of Heavy Roller

111. For compacting hot or cold patching material be sure to investigate the Wayer Impactor, 2,000 blows per minute tamps, finishes and cures. All data in Bulletin 25-8. Wayer Impactor Sales Co. 12 N. Third St., Columbus 15, Ohio.

How to Speed Curb and Gutter Work

126. Here's a 24-page bulletin illustrating form set-ups for every type of curb and gutter work. Send for Bulletin 2259 and learn how to speed up the job with Blaw-Knox Steel Street Forms. Write Blaw-Knox, Dept. PW, Farmers Bank Bldg., Pittsburgh 22, Pa.

Adhesive Joint Sealers and How They Are Applied

130. Learn how joints are prepared and Flintseal Hot-Poured Joint-Sealing compound applied. Series of pictures shows each step and explains every operation for good joint construction. On request from The Flintkote Co., Dept. PW, 30 Rockefeller Plaza, New York 20, N. Y.

Uniform Spreading 2 to 10 ft. Wide

136. Saves labor, spreads 0 to 100 lbs. a sq. yd., dusts up to 1" material forward, reverse, on curves, hills or straightaway. Assures uniform, even density of spread. Write for bulletin: Dept. PW., All Purpose Spreader Co., Fuller Road, Elyria, Ohio.

POWER AND LIGHT

Diesel Engines to Help You Build Profits

27. A new 28 page catalog just off the press titled "Superior Stationary Diesel Engines," is packed with facts that will help you build profits. For your copy write to Superior Engine Division, National Supply Company, Springfield, Ohio.

Your Property Is Worth Good Protection

39. When installing link fence you want protection against rust and corrosion as well as vandalism. Investigate chain link fence made of "Konik" metal described in "Planned Protection" published by Continental Steel Corp., Kokomo, Ind.

CONSTRUCTION EQUIPMENT

Hydraulic Dump Bodies For Every Purpose

61. There's a hydraulic hoist or dump body designed and built to fill your need. Hercules bodies are designed to do a specific job in less time and at a lower cost. Specifications and data on the complete Hercules line available without obligation by writing to Dept. PW, Hercules Steel Products Corp., Galion, Ohio.

Contractors' Pump Features Carryability

93. To find out how well a Homelite Carryable Pump handles large volumes, seepage, mud, write today for illustrated bulletin L-503 containing data of great value to all pump users. Write Dept. PW, Homelite Corp., 2102 Riverdale Ave., Port Chester, N. Y.

Data and Pictures of Complete Line of New Ford Trucks

94. Check this number on the coupon for colorful circular showing new Ford Trucks for every hauling need, available in great variety of standard, factory-built chassis and body combinations. Be sure to check these trucks on your job. Truck and Fleet Sales Dept., Ford Motor Co., Dearborn, Mich.

52-Page Data-Packed Bulletin On Contractors Pumps

95. Tables for pump size determination on every excavation job, pipe friction loss, altitude effects and lots of other valuable data are included in this comprehensive booklet illustrating the many Jaeger "sure-prime" pump applications. Get your copy (catalog P45) by checking our coupon or writing the Jaeger Machine Co., Dept. PW, Columbus 16, Ohio.

Special Pumps to Fit Any Dewatering Job

101. Centrifugal Pumps. Long lasting, self-priming, non-clogging pumps for quickly dewatering trenches and similar construction jobs. Ask for Bulletin 7-LW-13. Gorman-Rupp Co., 320 No. Bowman St., Mansfield, Ohio.

The Right Tractor for Your Job

116. Whether you need a front-end loader, snow plow, bulldozer, sweeper or mover, International wheel tractors combine correctly with allied equipment to do the job. Your choice of gasoline or diesel units is illustrated in Bulletin A-103JJ. International Harvester Co., 180 No. Michigan Ave., Chicago 1, Ill.

SEWERAGE AND REFUSE

How You Can Clean Sewers From Streets Easily and Inexpensively

23. 32-page illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boulevard, Los Angeles 34, Calif.

Rust Wastes Your Money

121. You'll want data on the all-purpose anti-rust coating that can be brushed or sprayed on all metal surfaces, even those already attacked by rust. For full information on this firm, elastic coating write Rust-Oleum Corp., 2443 Oakton St., Evanston, Ill.

Sewage Plant Gas Storage Facilities

62. General information on estimating figures on Hortonspheres to store surplus gas produced in digesters at sewage disposal plants supplied by Chicago Bridge & Iron Company, 2115 McCormick Bldg., Chicago 4, Ill. Hortonspheres are built in sizes up to 65 ft. diameter for pressures as high as 60 pounds per sq. in. for storage at sewage plants utilizing digester gas.

Aeration and Final Clarification In a Single Tank

92. The "Package Aerifier" for small sewage treatment plants employs the activated sludge process. Ideal for isolated institutions and industrial plants, and communities of 600 to 3500 population. Complete data in bulletin 6651 from Yeomans Brothers Co., 1425 N. Dayton St., Chicago 22, Ill.

Your Laboratory Needs Reliable Equipment

118. Laboratory apparatus and C. P. chemicals; incubators, microscopes, pH meters, turbidimeters, etc. can be obtained from any of the five branches of the Harshaw Scientific Div. Get bulletins from Dept. PW, Harshaw Chemical Co., Cleveland 6, Ohio.

Need Low-Cost Air For Sewage Treatment?

122. New 20-page booklet shows operting and construction features of Rotary positive Blowers engineered to fit your needs. Air for activated sludge, water treatment; constant vacuum for filtering. Bulletin 22-23-B-13 gives details. Roots-Connersville Blower Corp., 712 Poplar Ave., Connersville, Ind.

Packaged Sewage Treatment—Just Right for Small Places

36. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

Design Details for Sludge Collectors

42. Booklet No. P.W. 1742 on Link-Belt Circuline Collectors contains sanitary engineering data and design details. Catalog No. 1742 on Straightline Collectors, contains layout drawings, illustration pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

WATER WORKS

Makes Underground Pipe Installations Easy

25. One-man operated Hydraulic Pipe Pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts and prices, ask for booklet S-117, Greenlee Tool Co., 2052 Columbia Ave., Rockford, Ill.

Two-Way FM Radio Telephone Equipment for All Departments

26. For booklet describing and illustrating the Motorola Two-Way Radio Telephone or for specific recommendations concerning your application write to Dept. PW, Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.

16-Page Booklet Tells Meter Advantages

33. 100% metering as practiced by many cities requires accurate, dependable meters with interchangeable parts. Cutaway views of every part, capacity and size data are all included in handsome American-Niagara water meter booklet available from Buffalo Meter Co., 2920 Main St., Buffalo 14, N. Y.

Chem-O-Feeders for Automatic Chemical Feeding

60. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation, treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. %, 96 Codding St., Providence 1, R. I.

Solve Corrosion Problems With This Special Alloy

41. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

Eliminate Taste and Odor From Your Water

53. Technical pub. No. P.W. 213 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with Break-Point Chlorination. Send free to any operator requesting it.

Helpful Data on Hydrants

64. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Dept. P.W., Anniston, Ala.

Cast Iron Pipe and Fittings For Every Need

65. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Dept. PW, Burlington, N. J.

To Measure, Mix, Feed Chlorine or Other Gases

58. Everson SterElators. Bulletins 1063, 1066, 708 and others describe this device for measuring, mixing and feeding chlorine or other gases in solution. Capacities range from ¼ lb. to 2,000 lb. of gas per 24 hours. Address: Everson Manufacturing Co., 214 W. Huron St., Chicago 10, Ill.

88 Page Book Helps Solve Water Problems

71. pH and Chlorine Control. A discussion of pH control and description of comparators, chlorimeters and similar devices. An 88 page booklet. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

Speedier, Space-Saving Purification Apparatus

81. A new 12-page bulletin, No. 2204, tells how the Spaulding Precipitator, in removing impurities from a liquid by precipitation, adsorption, settling, and upward filtration, occupies less space, uses less chemicals and speeds up treatment. Permutit Co., 330 West 42nd St., New York 18, N. Y.

How to Estimate Quantity Of Joint Compound Needed

87. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in bulletins issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Flow Meters With Many New Features

91. The new Propelflo meter for main-line metering introduces many new features you will want to look into. Send for latest bulletin today. Builders Providence, Inc., 16 Codding St., Providence 1, R. I.

Pipe That Is Immune to Tuberculation and Corrosion

104. Transite Pipe. The high strength and low weight of pipe moulded under pressure from asbestos fibre and cement, together with its immunity to tuberculation and corrosion is the subject of a 32-page pamphlet. Johns-Manville, Box 290, New York 16, N. Y.

Well Water Systems Built to Last

105. Layne pumps are built for wells ranging from 4" to 36" diameter and in capacities from 50 to 16,000 gpm. Full engineering data and many installation views are given in 32 page Pump Bulletin 4-42. Layne and Bowler, Inc., Memphis, Tenn.

Pressure Pipe That Retains Capacity

106. Several bulletins describing the construction of pressure pipe, list of installations, carrying capacity tests, making service connections under pressure; and detail descriptions of several installations. Lock Joint Pipe Co., P.O. Box 269, East Orange.

Full Data on Method and Results Of Water Main Cleaning

107. Water main cleaning by the National Method is title of 4-page folder describing methods and results obtained, with full data. National Water Main Cleaning Co., 30 Church St., New York 7, N. Y.

You Can Depend On These Valves

112. Rigidly inspected gate valves for pressures up to 175 lbs. by R. D. Wood Co Sizes 2" to 30"; for any standard type joint R. D. Wood Co., Public Ledger Bldg., Philadelphia 5, Pa.

Handy Catalog Describes Small Hydrants, Drinking Fountains

115. This 44-page catalog describes ¾" to 2" hydrants. Also street washers, drinking fountains and other water service devices. The Murdock Mfg. & Supply Co., 426 Plum Street, Cincinnati 2, Ohio.

How to Get Good Lawns For Your Water Plant

123. For every step in lawn care and seasonable maintenance hints be sure to read "Lawn Care," an interesting periodical sent without obligation by O. M. Scott & Sons Co., 81 Spring St., Marysville, Ohio.

Do You Ever Have Leaks to Fix?

124. You'll want to know about the full line of "Skinner-Seal" clamps for repairing bell and socket joint leaks and broken mains. Step-by-step procedures are illustrated in catalog 41, a handsome 40-page presentation which shows applications of all fittings. Write M. B. Skinner Co., Dept. PW, South Bend 21, Ind.

Be Sure You Know How Much You Pump

125. Sparling Main-Line water meters are suited for your metering needs at pumping station and treatment plant. Recording, automatic and remote control units are described in bulletin 310. R. W. Sparling, Box 3277, Los Angeles, Calif.

The Modern Way to Filter Swimming Pool Water

129. That's the title of a bulletin full of facts about Bowsers' new diatomite filter to produce clear, sparkling, clean water at low cost. Occupies small space, doesn't waste water. Gives sizes to use, performance charts, etc. Write Bowser, Inc., Dept. PW, 1395 Creighton Ave., Ft. Wayne, Ind.

All About Cement-Mortar Lining of Water Mains

133. Here, in a really beautiful booklet, is practically everything you need to know about this method of lining mains in place—the needs, methods, and results that will interest you. Centriline Corp., Dept. PW, 140 Cedar St., New York 6, N. Y.

NEWS OF ENGINEERS

Lester D. Lee, formerly of the City Engineer's staff, Milwaukee, Wisc., is now associated with Hitchcock & Estabrook, consulting engineers, Sexton Bldg., Minneapolis 15, Minn.

The firm of Jones & Henry, consulting sanitary engineers, Security Bldg., Toledo, O., has admitted to partnership George N. Schoonmaker, Spencer D. Downing, Bernal H. Swab and Leon G. Williams. The name of the firm was changed, effective Feb. 1, to Jones, Henry & Schoonmaker. Mr. Schoonmaker was city manager of Toledo from 1939 to 1949. Messrs. Downing, Swab and Williams have been with Jones & Henry for some time.

William R. Seeger, formerly assistant chief engineer of the Marin Municipal Water District, Calif., has been appointed assistant general manager, effective Jan. 1, 1949.

Willard S. Conlon has resigned as city manager of La Junta, Colorado.

Raymond B. Seymour, formerly chief chemist of Atlas Mineral Products Co., has returned to that firm as executive vice-president and general manager. George L. Wirtz is president.

Charles E. Kauffman, research engineer at Hall Laboratories, Inc., Pittsburgh, has been made assistant director of research. Dr. Thomas H. Daugherty has been appointed assistant director of chemical research for Calgon, Inc.

Andre S. Rubin, Jr., has been appointed sales manager of Marlow Pumps, Ridgewood, N. J.

Paulis P. Bijlaard, and Arthur J. McNair have been appointed associate professors of civil engineering at Cornell University, and Floyd O. Slate has been made associate professor of engineering materials.

Water Conditioning Firms Join Forces

Announcement has been made of the joining of Elgin Softener Corp., Elgin, Ill., and Illinois Water Treatment Co. Rockford, Ill. Each company will maintain its name identity and personnel, but manufacturing operations will be consolidated.

ENGINEER WANTED

The City of Wahpeton, North Dakota (5,000) is receiving applications for the position of City Engineer. Department includes supervision of water supply, sewage disposal and general municipal engineering. Details may be secured by writing to Mr. A. W. Hoppert, Mayor.

FOR SALE

Vacuum filter, 50 sq. ft. area, complete with all accessories including chemical proportioning pump and feeder. Ideal for experimental and test work, pilot plant, or for small sewage treatment plant. We are installing larger unit. Chandler Borden, Village Clerk, Liberty, N. Y.